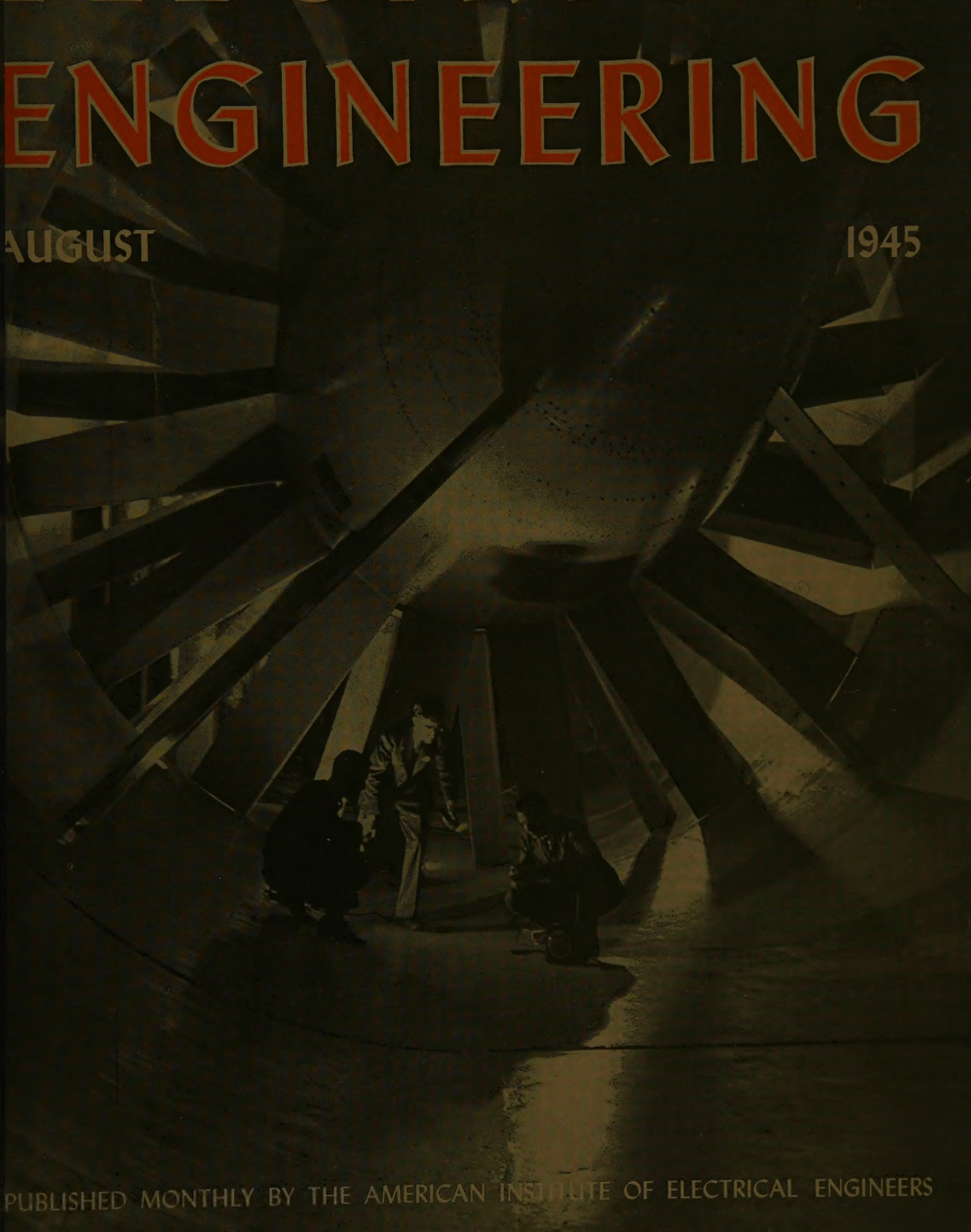
ELECTRICAL ENGINEERING

AUGUST 1945



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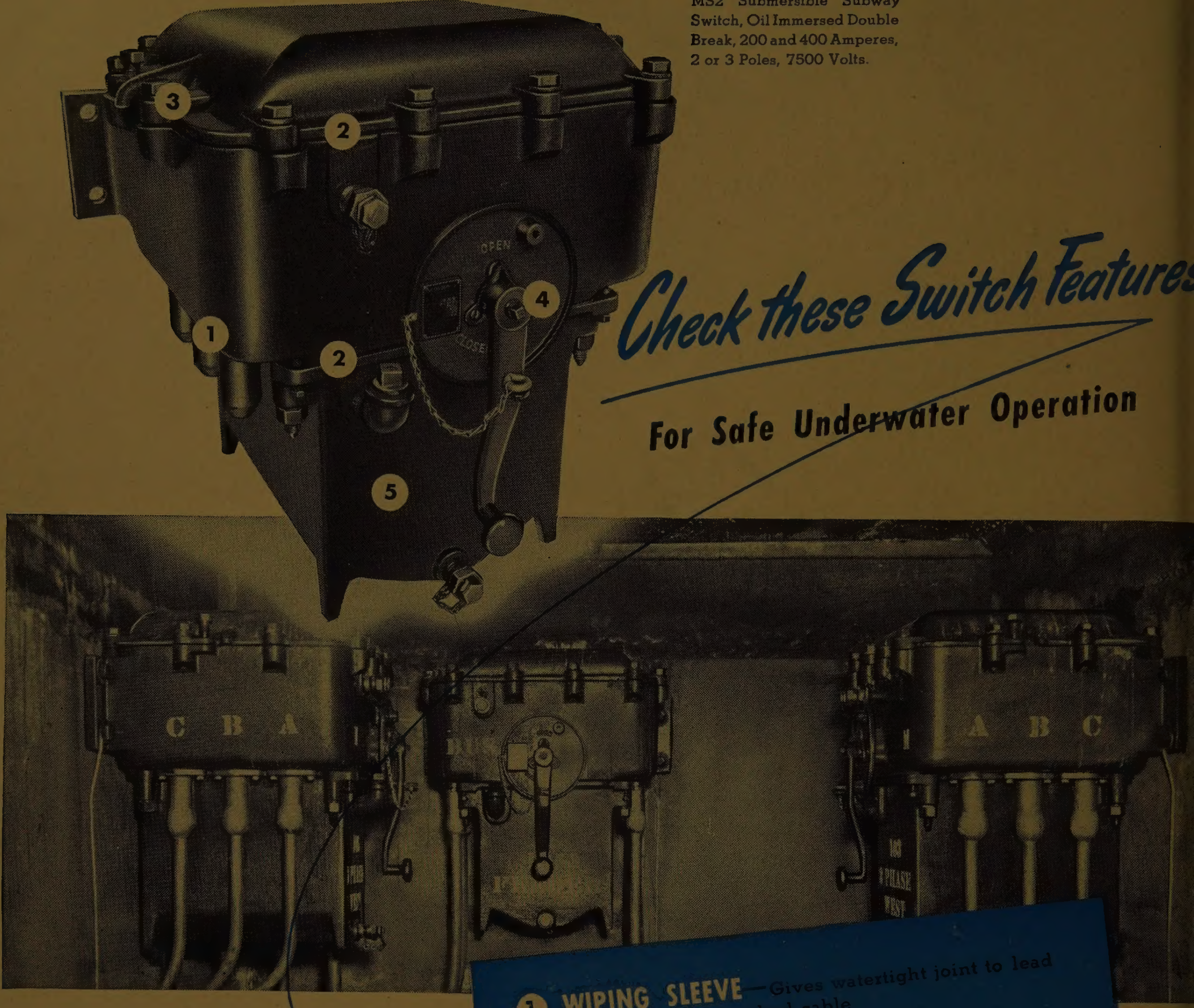

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The Cover: This 16-bladed 24-foot fan in the wind tunnel of the Allen Memorial Aeronautical Laboratories which generates wind velocities approaching the speed of sound has a top speed of 490 revolutions per minute and is powered by an 18,000-horsepower motor. Projecting from its hub is a conical-shaped fairing which prevents turbulence of air. Boeing Aircraft Company photo

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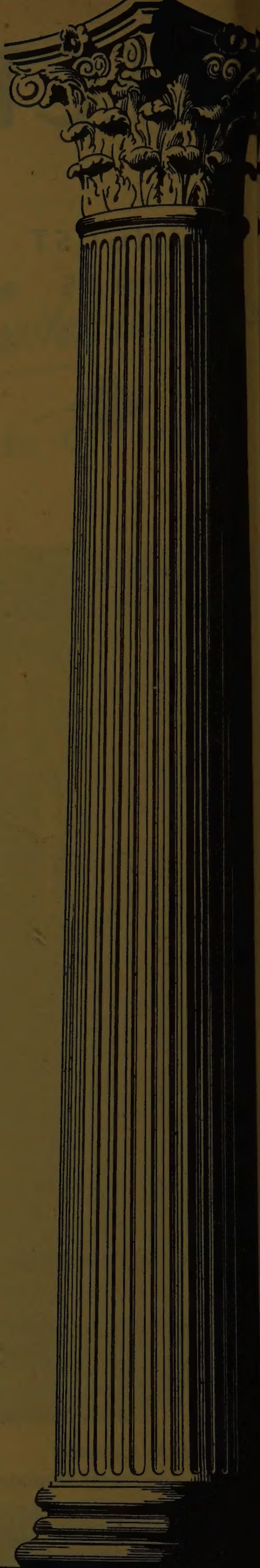

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LECTRICAL ENGINEERING
OLUME 64, NUMBER 8 AUGUST 1945

Ship's Service Power Systems for Naval Vessels

H. G. RICKOVER
MEMBER AIEE

Equipment of ship's service electric power and distribution systems for naval vessels, the contrasting conditions of electric power systems on shore and on board ship, and the progress of these systems over the past several years are described in detail in this article.

INCE 1883 when a 13.2-kw d-c lighting generator was installed on the crusier *renton,* the use of electricity on naval ssels has increased so much that today odern battleships have as much generat- g capacity installed for ship's service wer and lighting as would be required serve a city of approximately 125,000 ople. Almost every function involved in e operation of the vessel for whatever ission it may have been designed relies large part on electric power. In fact, ilure of this power may mean the dis- ility or even the complete loss of the ssel.

The two general types of electric systems stalled on naval vessels are the electric opulsion, and ship's service electric sys- ms. As the purpose of this paper is to scribe some of the aspects involved in e design of ship's service power and dis- ibution systems on modern naval vessels, discussion of electric propulsion systems ll be given. Suffice it to say that an elec- c propulsion system consists of equip- ent necessary for the generation, distribu- n, control, and utilization of electric wer and forms a flexible transmission edium between the prime movers and e propellers.

Nearly all shore electric-power systems nsist of a network of power stations linked gether. This may include several sta- ns in the same locality or may extend a large number of steam and hydraulic ants covering several states. Thus, the mporary loss of the local plant normally ll not cause interruption of power as mands may be supplied by other plants nnected in the system. The condition board ship is quite different. A ship is tirely dependent upon its own plant d in case of operating difficulties cannot ok to outside activities temporarily to pply power or to assist in returning the ant to operation. Furthermore, electric nerating plants and distribution systems on naval vessels must be capable of operating under conditions of heavy shock, heavy roll and pitch, and under extreme atmospheric conditions. It is therefore mandatory that naval vessels be provided with the most reliable and rugged equipment.

DESIGN OF A NEW NAVAL VESSEL

Whenever a new type of naval vessel is to be constructed, the Navy General Board specifies the characteristics, purpose, and special features of the vessel. After approval by the Secretary of the Navy, a directive is issued to the Bureau of Ships to have the vessel constructed. Based on the information received from the General Board and the Secretary, the Bureau of Ships determines the design of the hull, details of the machinery including type of propulsion to be furnished, and the type of electric plant to be installed. Specifications, and contract plans showing general contours of the hull, compartmentation, and arrangement of the machinery are prepared by the Bureau of Ships. These contract plans and specifications are used in the preparation of the builders' plans.

D-C SYSTEMS

Surface naval vessels designed prior to 1933, smaller vessels of present design, and many vessels converted for naval use are equipped with d-c ship's service electric systems. Some of these are 240/120-volt three-wire systems with lighting supplied at 120 volts and power loads at 240 volts. Some have 120-volt systems for both power and lighting. Where alternating current is required for special application on vessels having d-c systems, it is supplied by motor generator sets or by independent a-c generators installed for the particular requirement. All submarines have d-c ship's service systems with power taken from the main storage batteries when submerged and from the batteries or a Diesel-driven auxiliary generator when on the surface. The voltage of the ship's service system is different in the several classes of submarines, depending on the number of cells in the main storage batteries. Submarine lighting circuits are either direct current supplied from the storage batteries or through motor generator sets, or alternating current supplied through motor generator sets.

A-C SYSTEMS

Battleships, aircraft carriers, cruisers, destroyers, destroyer escorts, and the large auxiliary vessels designed since 1933 are provided with 450-volt three-phase 60-cycle a-c systems. Lighting circuits at 117 volts are supplied by step-down transformers taking power from the 450-volt line. A few of the earlier installations and some vessels converted to naval use have a-c systems of different voltage or frequency. Where direct current is required for special applications, such as searchlights or "degaussing," it is usually provided by motor generators. On destroyers and smaller vessels direct current is supplied by oversize exciters direct-connected to the a-c ship's service generator sets.

SHIP'S SERVICE GENERATORS

The size of the electric plant is determined after the type and size of the vessel have been specified, and all the propulsion- and auxiliary-machinery requirements are known. The capacity of the electric plant is based on a power analysis of the vessel operating under conditions requiring the maximum amount of electric power. On combat vessels this condition would exist when the vessel is in battle, whereas on naval auxiliary vessels, such as a destroyer tender, the maximum load would occur when the vessel is utilizing most of its shop

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ed on an address presented at the AIEE winter nical meeting, New York, N. Y., January 24–28, 4.

G. Rickover is a captain in the United States Navy, shington, D. C.

equipment. Likewise, for cargo-carrying vessels, such as a tanker, the maximum demand for electric power would occur when the vessel is using the large oil-handling pumps. Thus every operating condition for each type of vessel must be carefully studied to estimate the maximum demand for electric power.

In most cases, the total plant has capacity to carry twice the calculated maximum electric-power load. The excess capacity is provided for two major purposes:

1. For sufficient power to operate under conditions where 50 per cent of the electric plant has been lost.

2. To allow for increased electric loads, such as additional guns, new or larger auxiliaries, and new communication equipment.

After the required amount of electric power has been determined, standard-size generators of a rating to obtain as many units as practicable without jeopardizing operating efficiency are selected. These are known as ship's service generators, and are usually controlled from either two or four generator and distribution switchboards, depending on the number of generators installed and the type of the vessel. In addition to the ship's service generators, one or two Diesel-powered emergency generators are installed in locations widely separated from the main electric-power plant, for use when the ship's service generators are inoperative. The locations of the generators and switchboards are selected to obtain as much separation as practicable so that damage to any one section of the vessel will not disable the entire electric plant. On large vessels, the switchboards are separated from one another by at least one watertight compartment.

CHARACTERISTICS OF GENERATORS AND VOLTAGE REGULATORS

Turbine or Diesel-driven generators or both are installed in naval vessels. On ships having steam or steam-electric propulsion, turbogenerators supply the ship's service power, while Diesel generators are used for emergency service. Diesel-propelled ships use Diesel generators for ship's service power.

A-c turbogenerator sets range in size from 200 to 1,500 kw and consist of a turbine of the solid-rotor design running at speeds of from 8,000 to 10,000 rpm having either a single or double helical gear with a 60-cycle 1,200-rpm generator and a direct-connected exciter. D-c turbogenerator sets range in size from 60 to 750 kw and consist of a turbine of the built-up rotor design running at speeds of approximately 6,000 rpm with a single helical reduction gear connecting a 1,200-rpm generator.

Diesel-generator sets consist of a Diesel engine of either the two- or four-cycle type and a direct-connected generator of 10 to 500 kw direct current or 30 to 850 kw, 60 cycles, alternating current, running at speeds from 600 to approximately 1,200 rpm. Diesel-driven a-c generators employ direct-connected exciters.

Due to special conditions incident to naval operation, generators must incorporate many mechanical features not required for shore installations. They must be as small and light as design will permit and constructed for maximum reliability and ease of maintenance. They must be constructed of steel throughout to withstand shock and must have maximum rigidity to insure operation during roll and pitch of the vessel. They must have clearances, creepage distances, and insulation adequate to withstand ambient temperatures of 50 degrees centigrade and adverse conditions of humidity, salt air, and oil vapors incident to the machinery spaces.

Many special design features, particularly for a-c machines, are likewise required. Practically all a-c generators are of the salient-pole design. Operating conditions require that the transient reactance not exceed 17 to 27 per cent and that the subtransient reactance meet requirements of 10 to 13.2 per cent (depending upon the size of the machine). The short-circuit ratio is greater than 1.0, the negative-sequence reactance is kept small (average value of 15 per cent), and the response of the voltage-regulating system is much higher than required by commercial designs.

These design limitations have been determined from extensive developments and tests conducted by both the Bureau of Ships and the electrical manufacturers and are in keeping with the following considerations:

(*a*). The relatively small size of the electric plant compared with the total connected load.

(*b*). The desire to eliminate superfluous equipment such as reduced-voltage-type motor starters.

(*c*). The large single-phase loads which are present in certain types of vessels resulting in phase current and voltage unbalance.

(*d*). The need to control instantaneous and sustained values of generator short-circuit current in order to co-ordinate circuit-breaker selective tripping and to limit the short-circuit current to values within interrupting capacity of the circuit breakers.

(*e*). The desire for maximum stability in the generator system.

(*f*). The need to reduce to a minimum the voltage disturbance (dip and length of time to recover to approximately normal) resulting from the sudden application (motor starting) of low-power-factor loads in the range of 50 to 100 per cent of the current rating of the generator supply.

Integral parts of the generating system are the exciter and the voltage regulator. Due to their superior performance and low maintenance, all voltage-regulating systems being provided for new naval vessels employ either the direct-acting rheostatic type, functioning in the field of a standard shunt or stabilized shunt exciter, or a rotary-amplifier type. The latter is a recently developed regulator consisting of a specially designed exciter whose output to the field of the a-c generator is a predetermined function of a system voltage change as interpreted by a static control device. Within the limits set by the generator reactances and time constants, the regulating system is responsible for maintaining regulated voltage under gradual changes of load and also for minimizing the time and amount of voltage dips or rises on sudden application or removal of large loads. These features as well as many other regulator operational points are rigidly specified and the generators tested for compliance.

Additional limitations are placed upon the generator designer because circuit breakers employing shunt trip coils are operated from the varying exciter voltages. Since these coils can operate only over a given range of voltage, the designer is limited to a maximum–minimum voltage range for excitation purposes. Although these special requirements tend to increase the size of generators, units constructed for naval use and meeting specification requirements are lower in weight and smaller in size than commercial generators of comparable ratings.

D-c generators of the straight shunt type are used for all except a few special applications. Shunt generators are preferred because of their stable parallel operation without the use of equalizer connections.

SHIP'S SERVICE DISTRIBUTION SYSTEMS

The design of the ship's service power distribution system is governed by the following requirements which are essential for naval vessels:

(*a*). Maximum reliability and continuity of service.

(*b*). Simplicity of operation and ease of maintenance.

(*c*). Flexibility to meet growing or changing-load conditions with minimum disturbance to the original system.

(*d*). Minimum weight and space.

The elements of a typical ship's service power-distribution system are shown in Figure 1. It is a radial system with provisions for interconnecting the main power sources by means of bus-tie circuits between the main switchboards so as to form a closed loop. In addition to the ship's service generating plant and distribution system, an emergency ship's service power system is also provided. This consists of one or more Diesel-engine-driven generators, associated switchboards, and distribution system. The emergency distribution system is energized by normal and alternate feeders from the main power system through bus-transfer switches. Upon failure of both of these supplies, the

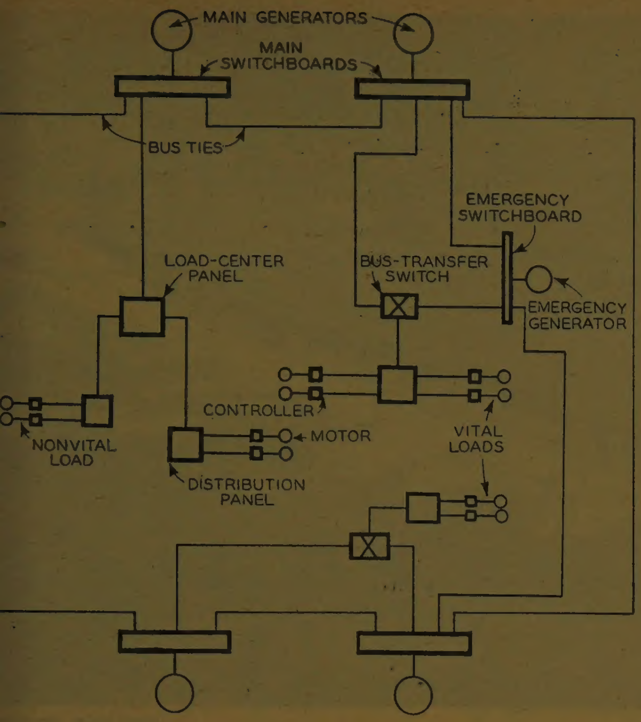

Figure 1. Typical ship's service power distribution system

nergency Diesel generator is automati- lly started and connected to the emer- ency bus.

A-c systems are used in the majority of stallations, particularly those of large apacity. Power is generated and dis- ributed at 450 volts, three phase, 60 ycles, and the system is delta-connected nd ungrounded. Electric auxiliaries are uilt for 440 volts. Lighting and miscel- neous small-power loads are supplied t 117 volts through step-down trans- rmers. D-c systems are used on some essels where the majority of the auxili- ries require wide speed control such as on lvage vessels or vessels having a large umber of cranes or hoists. D-c systems re ungrounded and are either 120 volts, vo wire, or 120/240 volts, three wire, epending on the size of the total load nd the ratio of power to lighting loads.

For a-c systems each individual load, at is, motor or transformer, is supplied by separate feeder from a distribution panel. nsofar as practicable all loads associated ith a common function, or closely re- ted to that function, are supplied from e same distribution panel. The distri- ution panels are in turn supplied from e main switchboard either directly or rough load centers. Load-center panels re located in the approximate center of e load area. Some vital loads, such as e steering gear and main turrets, are ways supplied directly from the main vitchboard.

In arranging the loads on distribution anels and load centers all nonvital loads, ich as galleys and shops, are segregated om vital loads such as guns, steering ear, and engine-room auxiliaries. Feeder rcuits to nonvital loads are called general rcuits, and those to vital loads are called attle circuits. The latter are run within armor protection where it is practicable.

All vital electric loads are provided with at least two sources of supply. This is accomplished by means of a normal feeder from one main switchboard and either an alternate feeder from another main switchboard or an emergency feeder from one of the emergency switchboards. It would be desirable to obtain standby power for all vital loads from the emergency system. However, the emergency generating plant is of small capacity with respect to the main plant and to the size of the total vital load. For this reason certain large vital loads, such as main turrets, catapults, and airplane elevators, invariably receive standby power by means of an alternate feeder from another main switchboard. The steering gear is often supplied with an emergency feeder in addition to normal and alternate feeders.

Transfer of the vital loads from the normal to the standby power source is accomplished by bus-transfer switches. Manual bus-transfer switches are preferred because of their greater reliability and simplicity of operation. However, automatic bus-transfer switches are used under the following conditions:

(*a*). Where the location of the bus-transfer switch must be remote from or not readily accessible to the electric auxiliary which it supplies.

(*b*). For the steering gear on vessels provided with one rudder.

(*c*). On vital loads where rapid restoration of power supply is essential.

A time delay is provided in the transfer operation of all bus-transfer switches to avoid excessive current transients during switching.

In providing standby-power sources to vital loads, the selection of the power source (generators and switchboards) and the arrangement of the cable runs for the normal, alternate, or emergency feeders are such as to obtain the maximum separation afforded by the compartmentation of the vessel, and the cables are protected by armor to the greatest practicable extent.

Voltage drop seldom determines the cable sizes in ship's service distribution systems because of the low per-unit impedance of the cables and the short length of the circuits involved. However, it is necessary that the voltage drops be checked and the system regulation maintained within definite limits. On d-c systems the permissible cable-voltage drop is 8 per cent while on a-c systems the drop is limited to 6 per cent under normal operation and to 12 per cent under motor-starting conditions. On a-c systems it is particularly important to check the cable-voltage drop under motor-starting conditions to ensure adequate motor-starting torque and to avoid applying excessively low voltage momentarily to motors already running.

With current-carrying capacity the dominant factor in the choice of cable sizes, the connected loads must be carefully analyzed to determine the maximum demand load on each feeder circuit if a distribution system of minimum weight yet adequate capacity is to be obtained. The calculation of feeder loads involves consideration of the following:

(*a*). The function of each auxiliary connected to the feeder to ascertain the diversity of loading.

(*b*). The character of each load, that is, whether intermittent or continuous.

(*c*). The allowance of suitable spare capacity for load growth.

In evaluating each of the above factors and to arrive at a maximum load on the feeder circuit, the several possible operating conditions of the vessel (anchor, cruising, battle) are studied. In addition, the influence of the short-time rating of the cable is considered, particularly where the load is of a widely fluctuating nature.

The current-carrying capacity of cables is influenced by the ambient temperature, grouping of the cables, and thermal characteristics of the surrounding materials. In naval service, the large number of cables, limited space, restricted ventilation, and localized high ambient temperatures combine to produce installation conditions particularly unfavorable from the standpoint of cable current-carrying capacity.

The increase in the use of electrically driven auxiliaries on naval vessels has produced large increases in the installed generating capacity. This fact, together with the necessity for maintaining a high degree of reliability and continuity of service, has emphasized the importance of providing adequate fault protection. Such protection is primarily concerned with the automatic isolation of a fault with mini-

United States Navy photo

mum damage and with minimum disturbance to the remainder of the system. Automatic thermal overload protection of the system is not required since reliance is placed on personal supervision to avoid excessive loading.

The basic requirements for fault protection on ship's service power distribution systems are as follows:

(*a*). Maximum protection of electric apparatus and circuits.

(*b*). High-speed clearing of faults.

(*c*). Selective operation under fault conditions.

(*d*). Adequate interrupting capacity in all circuit-protective devices or the provision of suitable back-up protection.

(*e*). Adequate thermal capacity in all circuit-protective devices.

(*f*). Simplicity of operation and ease of maintenance.

The need for simplicity of operation and ease of maintenance plus restricted space requirements makes it necessary to avoid the use of complex types of fault-protective systems requiring a large number of relays, current transformers, and pilot wires. For this reason, circuit breakers having integral direct-acting inverse-time-delay overcurrent-trip attachments are the most satisfactory method of securing fault protection on ship's service power systems. However, on bus-tie and generator circuit breakers, inverse-time-delay overcurrent relays are used to trip the circuit breaker through a d-c shunt trip coil energized from the generator exciter.

To obtain selective operation of the protective devices over the wide range of possible fault currents using inverse-time-delay overcurrent protection exclusively, reliance is placed on providing successively increasing time delay on each protective device in series between the load and the generator. On this basis very close tolerances are required on the time–current tripping characteristics of each protective device in order to avoid excessively long time settings on the generator and bus-tie circuit breakers and consequent delay in clearing bus faults. The development of special tripping devices has been necessary in order to achieve desired operation.

Figure 2. Port-bow aerial view of an aircraft carrier

In order to provide adequate and reliable fault protection the designer must know the value of current to be expected on short circuits. Calculations are made of

1. The maximum available short-circuit currents to determine the required interrupting ratings of the circuit breakers.

2. The minimum available short-circuit current to check the minimum trip point of the protective devices.

3. The decrement curve of the short-circuit current of each generator to check the over-all co-ordination of the protective system.

DESIGN AND CONSTRUCTION OF SWITCHBOARDS

Many factors not normally considered for shore-installed switchboards assume major importance in the design and construction of switchboards for naval vessels. These switchboards must be capable of withstanding, without damage or maloperation, the severe mechanical shocks induced by enemy shells, torpedoes, bombs, and mines. Switchboards aboard naval vessels are subjected to severe lateral forces caused by rolling and pitching of the vessel. Temperatures in which these switchboards must operate are normally much higher than those encountered on shore. To complicate the problem more, limitations of available space and weight dictate that the switchboards be as small and light as practicable.

The necessity for operating naval vessels with newly trained personnel together with unpredictabilities of human reactions under stress of battle makes it imperative that switchboard operation be made simple. Similarly, automatic devices must be simple in construction and operation as delicate adjustments or repairs to intricate equipment may be impossible or require excessive time during critical periods.

To develop switchboards of maximum inherent reliability for these condition extensive studies and tests have been conducted. From these investigations the present switchboards for naval shipboard installations have emerged. They are o all-steel construction, dead-front, sectionalized, and they utilize bench-type contro units for mounting instruments and controls. In addition to the advantages o sectionalized construction in confining faults or fire, increased resistance to mechanical shock is obtained. For maximum strength and rigidity, box-type framework fabricated from steel angles and channel are used. Welded construction is used except for parts that must be removed for equipment repair or replacement. To prevent damage from water dripping or spraying into the switchboard, solid top sheet are used overhanging the front, rear, and side sheets. Solid end sheets are used but the rear enclosures are of expanded metal to permit inspection and the rapid application of carbon dioxide should a fire develop within the switchboard.

Switchboard sections are internally com-artmented to segregate circuit breakers rom the bus and to separate large circuit reakers from one another. Drawout-ype circuit breakers are used to facilitate heir rapid replacement without the neces-ity of contacting live parts or de-energizng the switchboard.

Bus work is rigidly supported to prevent s dislodgement under severe shock. pecial attention is given to the method of upporting bus work as severe shock can ause large deflections in unsupported ections causing flashovers or even welding f adjacent busses.

Improved insulating materials have been eveloped which have greatly increased re-resistant qualities and structural trength.

Special attention is given to the arrange-nent of instruments and control switches o as to permit rapid switchboard opera-ion under battle conditions. All com-onent parts (circuit breakers, relays, in-truments, and voltage regulators) are lesigned and constructed to be capable of roper operation under the severe condi-ions likely to be encountered.

LIGHTING SYSTEMS

Lighting systems on naval vessels are imilar to commercial installations except that weight, space, and reliability are given greater consideration. Incandescent lamps have proved to be the most reliable source of illumination. Fifty- and 100-watt lamps designed to withstand shock and vibration are used for all except special applications. Lighting is supplied from the 450-volt three-phase power system through step-down transformers to three-phase 117-volt distribution panels fitted with 60-ampere fused tumbler switches.

Lighting circuits essential to the operation of the vessel are provided with bus-transfer switches which automatically connect the lighting to a standby source of power in the event the normal source fails. The standby source for vital lighting circuits is usually the emergency Diesel generator. Portable battery-operated lanterns located along main passageways and in important work areas provide illumination in the event all other lighting fails.

In wartime, naval vessels must operate from sunset to sunrise under "darkened ship" conditions. No lights are to be visible from outside the vessel. Low-level red-light illumination is used for necessary instrument lighting on the bridge or other exposed areas. Low-level red-light illumination is also installed in crews' berth spaces and main passageways to provide for personnel movement in these areas. Red-light illumination has the further advantage of allowing personnel whose duties involve seeing objects or performing tasks in the dark to obtain and maintain dark adaptation of their eyes.

MAIN WIREWAYS

The numerous cables installed in a naval vessel are securely mounted in wireways. These consist of steel-frame hangers welded to the ship's structure. Where practicable they are located below the waterline since this location is less susceptible to damage from enemy gunfire. Where alternate feeders are provided for vital loads, each set of feeders is located in a different wireway. To prevent all feeders from being damaged by a single casualty, the wireways running in the same direction are separated by being located on opposite sides of the vessel or by being located on different decks.

Where possible, wireways are laid out to avoid passing through powder magazines or ammunition-handling rooms. This eliminates danger from overheated cables in these spaces in the event of a short circuit or overload. When it is impossible to route the cables through any other space, the cables are enclosed in a steel duct.

IDENTIFICATION TAGS

To assist in tracing or identifying any of the thousands of cables running through the average naval vessel, each cable is marked with a metal tag. The tags are attached to the cable on each side of a bulkhead or deck they pass through and are embossed with the feeder number or symbol. The tags are of different colors to indicate the different systems. To facilitate tracing of cables through the many wireways, individual damage diagrams are furnished. These show all important power systems and indicate the location of the feeders throughout their run. Normal and alternate sources of power are shown in different colors to assist in quick location under casualty conditions.

PROGRESS FROM EXPERIENCE

The design of ship's service electric power and distribution systems for naval vessels as outlined in this article is the culmination of experience gained from the operation of a large number of vessels under war conditions. With the co-operation of the electrical industry and the shipbuilding yards, new equipment was developed and system-design changes made as soon as practicable after operating experience indicated such action to be necessary. It is believed that considerable progress has been made during the past several years and that there will be fewer casualties resulting in the loss of all or a portion of ship's service electric power during battle periods. Constant studies and developments are being made to improve further the reliability of ship's service electric power and distribution systems.

X Rays Afford New Means of Chemical Analysis

Shooting a beam of X rays through an nknown chemical substance to see how nuch of the radiation is absorbed, is a apid means of identifying the elements of which the material is made. This method s being used in studies conducted by Herman A. Liebhafsky and E. H. Winslow n the research laboratory of the General Electric Company, Schenectady, N. Y. Doctor Liebhafsky explained that X rays re intimately related to the inner atom nd so furnish a means of counting the umber and indicating the kinds of atoms by which they are being absorbed.

Testing Methods

X-ray absorption as an analytical method is made practicable by a photo-electric X-ray intensity meter developed by H. Millard Smith, another General Electric research laboratory scientist. The nvisible X rays fall on a fluorescent ma-erial, which becomes luminous where they trike. This material, called a phosphor, s painted on the glass envelope of a phototube of the multiplier type. With uch a tube the light from the phosphor alls first on a sensitized surface within the ube and electrons are emitted from it. These electrons fall on a second surface rom which still more electrons, in larger uantities, are discharged. They fall on third surface and the yield is still further increased. Then even more stages are used. The electrons are multiplied and those from the last stage result in a small electric current which can be amplified still more with other electron tubes, and measured with an appropriate meter. The photoelectric meter can measure very weak intensity X rays and also can detect very slight variations in their intensity. For example, if the X rays are passed through a pile of 100 sheets of paper, the difference in absorption caused by the addition or removal of a single sheet produces a noticeable effect.

In the analytical method developed by Doctor Liebhafsky and Doctor Winslow, which has thus far only been set up experimentally, the solid or liquid sample is placed in a glass cell $^3/_4$ inch in diameter and 6 inches long. For gases a two-foot cell is employed. The cell is in a vertical position above the X-ray tube and a narrow pencil of the rays is sent upwards through it. The rays then fall on the phosphor around the multiplier phototube, which is enclosed in a lead housing. The current from the phototube is amplified and its intensity read on a meter. Comparisons are made of the absorption of the cell with and without the sample. Filters, made of various metals, can be placed in the X-ray beam to secure radiation of different wavelengths.

Use of Drugs in Resuscitation From Electric Shock

C. K. DRINKER

FOR MANY YEARS I have encountered the apparently irresistible compulsion of doctors to give some sort of hypodermic injection to patients overcome by carbon monoxide, close to death from submersion, or in desperate straits from electric shock. At one time in a long experience I listed, as well as the records permitted, the different drugs given in carbon-monoxide emergencies by ambulance physicians in New York, N. Y. Nothing in the traditional teaching of medical students was left out.

Let us consider an instance of electric shock in which the victim is being given artificial respiration, obviously unable to breathe, and whose heart and circulation may or may not be operating. The questions which arise are whether any drug can be administered which will at once improve the chances for reviving the breathing or aiding the condition of the circulation.

STIMULANTS TO BREATHING

The following drugs can be shown by animal experimentation to stimulate breathing. All can be given intravenously or under the skin by injection.

1. *Strychnine Sulphate.* This alkaloid has a stimulating action on the spinal cord, the medulla containing the respiratory center, and upon the brain. But in dosage of nonpoisonous size, strychnine has no appreciable effect on breathing and, when given in sufficient amount to stimulate breathing momentarily, is eventually depressing to respiration and thus adds to, rather than remedies, the condition of the patient. The fact is that all medical men have so wholesome a respect for strychnine as a poison, that such injections as are frequently given are so small as to be both ineffectual and harmless.

2. *Picrotoxin.* This drug is a strong stimulant to the nervous system, particularly the lower brain and medulla—where respiration originates. However, it has been shown that when enough picrotoxin is injected to stimulate breathing convulsions result. Picrotoxin, used carefully, under hospital conditions has proved useful in combating poisoning due to the barbiturates such as veronal, but has no place in emergency failure of breathing from electric shock.

3. *Metrazol.* This drug is related to camphor, and has had extensive use in the treatment of certain sorts of insanity by the production of generalized convulsions. This means it is a strong stimulant of the nervous system, but it has no conspicuous effect on breathing and has no value in respiratory failure from electric shock.

Stimulants to the heart and circulation—what they do, what they fail to do—observations on the practice of young doctors in treating "shock" cases and the findings of a long experience in the study of administering drugs, are discussed in this article by a medical doctor.

4. *Coramine* (*Nikethamide*). This is a relatively new drug and has some promise as a stimulant of a depressed breathing center. This value is, however, very uncertain and nothing so far claimed for it makes the compound worth serious consideration in electric-shock therapy.

5. *Caffeine Sodium Benzoate.* This caffeine compound is suitable for intravenous injection and caffeine, even in enormous dosage, seems devoid of harmful effects of serious sort. There is no doubt of the general stimulating effect of caffeine upon the central nervous system, breathing center included. I think it fair to describe the action as a sort of oiling of staggering nerve machinery. It thus makes normal processes in the breathing center go on more readily, and I know of no evidence that the drug can or has done harm. An intravenous injection of caffeine sodium benzoate is not out of place in any sort of respiratory depression, but the injection must be directly into the blood by vein, not a simple hypodermic (under the skin), since prompt action is imperative.

6. *Alpha Lobeline.* This drug had popularity as a respiratory stimulant about ten years ago, and has dropped out of use due to its very capricious effect as a stimulant to breathing and its emphatically disadvantageous effects on the heart and circulation.

STIMULANTS TO THE HEART AND CIRCULATION

The condition of the heart and the bloo circulation as a result of electric shock far better understood now than it wa even a few years ago. Divested of all th medical description possible, it seems t me the following circulatory derange ments may be met.

1. The shock, by passing through th medulla, may have stopped the breathin and left the circulation of the blood some what impaired but not seriously so. Th is the ideal case for resuscitation. But four or five minutes of absent breathin intervene before artificial respiration started, the heart and blood vessels wi begin to show the effects of oxygen lack Oxygen will remedy this condition an no injection or treatment other tha artificial respiration is required or ad visable.

2. The medulla, in addition to th breathing center, contains, in very sma space, the centers for regulating the hea rate, particularly for slowing the hea and for regulating the blood pressure b controlling the calibre of the smalle blood vessels. One may thus expe that a shock which stops breathing ca readily affect nearby units concerned wit the circulation. This occurs and, conse quently, the situations resulting may b quite varied. A few of them are as follow

(*a*). Breathing may be absent and the hea very slow and weak with low blood pressur

(*b*). Breathing may be present, the hea slow, and the blood pressure variable, bu becoming low.

(*c*). Breathing may be irregular with tendency to stop, the heart slow, irregul and weak, and the blood pressure low.

Obviously, these possible situatio may vary between themselves so that each case the condition of the circulatio can be appraised only by a compete physician. By "competence" I mean man capable in cardiology and with least some knowledge of the consequenc of electric shock. Very few doctors me this last requirement and so, lacking in th necessary discernment they supply trea ment which does not meet the speci requirements of the case.

Artificial respiration for absent inadequate breathing is, of course, esse tial, since lack of oxygen will make th condition of the circulation rapidly gro worse. If breathing is feeble and u reliable, the oxygen–carbon dioxide i

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alation is helpful. Absolute rest is nperative.

If the blood pressure continues to reain low and the heart feeble so that the atient begins to be in danger for circutory inadequacy, the physician may onsider giving an intravenous injection f a small dose of adrenin or ephedrine. n either case the injection should be iven very slowly and should be underood to be a last resort. Caffeine sodium enzoate, discussed in the section upon reathing, should have been given early i the management of the case and will ill benefit the circulation.

3. The shock by passing through the eart may cause ventricular fibrillation. he patient is dead white, not bluish. No ulse can be felt and after three or four reaths respiration ceases. Such patients re often given adrenin injections through e chest wall directly into the heart.

Evidence is increasing that ventricular brillation occurring spontaneously in nan, though usually fatal, occasionally eases with return of the heart to normal rhythmic beating. There is no reason to believe the same thing may not happen after electric shock, but such an event must be very rare.

There is no practical procedure which affects the fibrillating heart muscle and an intracardiac injection of adrenin can be relied upon to do but one thing; namely, make fibrillation worse, so that any chance of spontaneous shift to normal pulsation is lost.

These observations are intended in no way as a reflection on young doctors and their training. The drugs injected very definitely can be shown to stimulate breathing but not in the dosage or under the circumstances which are of consequence in the emergencies in which we are interested.

At the present time there is no substance which can be given by injection which benefits the breathing significantly. As stated in a foregoing paragraph, caffeine sodium benzoate intravenously may be useful but has no specific potency.

I believe the Edison Electric Institute might do well to consider financing research looking toward the discovery of some substance which will be of substantial aid to the respiratory center, much as does caffeine, but really efficient. I do not think any agency so completely dependent upon the attendance of a physician, as is an intravenous injection, can be of primary consequence in resuscitation from electric shock, but year by year we have instances of artificial respiration carried out for minutes to even many hours with eventual recovery. It must be clear to every one that the most our crews trained in artificial respiration accomplish during their period of effort is to substitute artificial breathing for absent natural breathing. They merely give the patient a chance to recover by arresting asphyxia. I believe more than this could be done in the direction of finding some direct aid to the respiratory center, and that in such a direction we will see our greatest advances in the resuscitation of the most serious electric accidents.

Electronic Control of Furnace Temperatures

The development of a vacuum-tube hermocouple device characterized by its nticipating nature, increases the sensiivity and response of conventional temerature controls by 1,000 per cent acording to M. J. Manjoine, research engineer of the Westinghouse Electric Corporaion, East Pittsburgh, Pa. This instrument onsists of two thermocouples of different hermal capacity and an electric heating lement, enclosed in an evacuated glass nvelope:

. To cause heating of the thermocouples y radiation.
2. To minimize room-temperature effects.
. To prevent deterioration of the elements.

Changes in electric-furnace temperaures are anticipated and corrective steps aken to minimize the cyclic swings in emperature characteristic of most furnace ontrols. When the temperature of a urnace is controlled by a single thermoouple within the heating chamber, the emperature rises sharply until it reaches a predetermined point where the control perates to disconnect the furnace from he power line. Because of the large hermal capacity of the heating elements nd the furnace itself, the temperature ontinues to rise to a maximum and then eginst of all. At a present minimum temerature which may coincide with the naximum, the controls again connect the furnace to the line. Here again the flywheel effect of the furnace thermal capacity causes the temperature to continue to drop until a minimum is reached at which point the temperature again begins to rise. The overshooting on the heating and cooling portions of the control cycle results in a considerable temperature range between the high and low temperatures of the cycle.

The anticipator, because of the different characteristics of the thermocouples used, reacts to temperature changes quicker than the furnace and initiates the control operation sooner and minimizes temperature fluctuation. The two thermocouples in the instrument and the control thermocouple in the furnace are connected in series so that the polarity of the couple with less thermal capacity is additive and the couple with greater thermal capacity is subtractive with respect to the furnace couple.

The heating element of the instrument is energized by the power source connecting the control mechanism and the relays that operate the main power contactors. Thus the furnace and instrument-heating elements operate together. The two couples in the instrument are equidistant from the heater but the element with the lesser thermal capacity is the one which reacts first to changes in heater-element temperature.

When the two couples in the anticipator are at the same temperature, the voltage from the control thermocouple to the control mechanism is constant. At the time that the control thermocouple institutes a change in control current, such as, starting the heating part of the cycle after it had been off, the change is felt first in the two thermocouples in the anticipator. However, the thermocouple with the lower thermal capacity heats faster than the other and the thermocouple voltage at the temperature control mechanism is increased. This increased voltage causes the controller to change to cooling, thus preventing the furnace temperature from overshooting the desired maximum. When the opposite action takes place and the furnace is in the cooling portion of the cycle, the anticipator thermocouple with larger thermal capacity cools more slowly and its reversed polarity causes the control mechanism to change to heating and keep the furnace temperature from overshooting the minimum limit. A variable resistance in the heater circuit of the anticipator provides a means of controlling the frequency of operation of this supervisory furnace-temperature control.

The instrument heater reflects the line voltage dip (or rise) much quicker than the furnace-heating elements and the control is properly energized to correct for the power variation before the need is recognized by the thermocouple in the furnace.

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Meteorology—Aid to Electrical Engineers

F. J. MAHAFFY

A meteorologist dispels popular notions upholding either the infallibility or the invariable error of the predictions of the "weather man." A middle-of-the-road discussion examines recent advances that have broadened the range and scope of weather prediction, the factors entering into the forecasting process, and specific meteorological information the electrical industry can expect for aid in both its long-range and day-to-day operations.

SINCE the beginning of the present war the science of meteorology has been the subject of increasing interest on the part of the general public and the popular press. Many articles have been published on the use which the military authorities are making of the science. It is claimed, for example, that the Nazis had accurate long-range forecasts on which they timed their campaigns in Poland and France. More recently a great deal has been heard of how the date for the invasion of Europe was decided by the meteorologists. In addition to this publicity various claims that the weather can be forecast weeks and even months ahead with surprising accuracy have been published. It is notable that such claims as the last have been confined to the popular press. Along with this heightened interest has gone a growing use of meteorology in various industrial and commercial activities.

The question that no doubt occurs to many persons is: why should meteorology now be receiving such prominence when it is not a new science and its use has not been considered worth while heretofore?

Two or three reasons exist for this. In the first place certain industries always are looking for new ways to improve their efficiency. In second place it is quite probable that certain benefits might have been obtained before, if the applications of meteorological science had received the intensive study they now are receiving. The principal reason, however, is that important advances have been made in the last few years in this science.

The main purpose of this article is to outline the importance of these advances, to try to outline in a realistic manner just what modern meteorology can do for the electrical engineer. It will try to penetrate the smoke screens of publicity and to avoid confusing what can be done now with what it is hoped can be done at some future time. Knowing this and also knowing what problems the weather creates for him, the engineer should be able to decide where he can put meteorology to practical use in his own field. A few places where the electrical engineer is now using meteorology are indicated and a few suggestions about where further study might be profitable are offered.

The average person has obtained most of his knowledge of meteorology in high school, where it was dealt with in two or three hours of a general-science course. It is a matter for regret that very few Canadian universities deal with the subject at all. This probably explains why the general knowledge of this subject in Canada is anywhere from 20 to 30 years behind present developments.

It is not intended to attempt a full outline of these developments, but to show:

1. What the advances in the science are that have increased its usefulness.

2. Just how far our present knowledge of meteorology enables us to go in the matter of weather prediction.

To do this it will be necessary to describe briefly the methods now being used.

In general those who have limited knowledge of the present state of the science seem to be subject to one of two errors—either they expect much more accuracy in the way of weather prediction than is now possible, or they ignore present possibilities which could prove very useful to them.

There is very little doubt that the science of weather is one of mankind's oldest. It affects all human activities so much that even primitive man was forced to give it his attention. During earlier times, however, it was mostly the province of the soothsayer or the astrologer. The numerous proverbs and superstitions about the weather all bear witness to this. On the other hand meteorology was one of the last sciences to receive serious scientific attention. The chief reason for this delay was that the development of meteorology had to wait upon developments in other sciences—in hydrodynamics, in thermodynamics, in radio and other electronic devices—and it might be added that the solution of many problems sti awaits the solution of allied problems i these or other fields. At any rate it wa not until the middle of the last centur when the development of the telegrap allowed the quick transmission of weathe reports, that the first successful attemp was made at weather forecasting. Sinc that time there has been a more or les steady advance in the science. It i assumed that most readers are familia with the weather map of 20 to 30 year ago, and only improvements since tha time will be enumerated.

The basis of any weather map consist of a series of weather observations mad all over the world. By internationa agreement all these are made at the sam hours. On the North American conti nent, for example, there are about 60 such stations extending from the Norther Arctic to Mexico reporting every six hour and often more frequently than thi These observations consist of such ele ments as barometric pressure and tend ency, wind, temperature, humidity, clou amount and type, precipitation, and s forth. Then by means of a complicate teletype and radio network these ar collected at central points and distribute to all forecasting centers. Except for th more remote stations, this usually is ac complished in about an hour and a ha from the observing time. As it is receive over the teletype, each observation plotted on its appropriate station on th weather map. When this is complete the forecaster is ready to take over. H first step is to locate what might be calle the elements controlling the weathe By drawing isobars, or lines of equa barometric pressure, areas of high pressu and areas of low pressure are define This is very similar to drawing conto lines on an ordinary map. By drawin lines of equal elevation the hills and valle will be defined corresponding to our are of high and low pressure. Isobars t us which way the air must flow. I electricity the current must flow fro high potential to low potential, and th volume of flow or amperage correspon to the potential gradient. In the atmo phere the wind velocity corresponds the pressure gradient, however, the dire tion, due to the effect of the earth's rot tion, is not from high to low pressure b along the isobars.

The next elements to be located are n so well known but are equally importan These are fronts. In recent years it h been found that the atmosphere is divide into different masses of air one of whic for example, moving up from the Gulf

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exico may be warm and moist, while other moving down from the Canadian ctic may be cold and dry. Between ese two air masses there usually will be zone or line across which the tempera-re or moisture content changes abruptly discontinuity, in mathematical lan-age. This zone or line is called a front. a result of the different densities in the o air masses warm air usually is being ted at these fronts, and condensation is king place as the pressure decreases. erefore these fronts are the cause of a ge percentage of the bad weather fects that we experience.

When these controlling elements have en located, the next step is to determine e rate and direction in which the centers d fronts are moving and to determine here they will be 12 or 24 hours ahead. this is known, then what sections will experiencing good or bad weather at at time should be known. For example e map may show that a cold front lies rth–south through Toronto with an ea of high pressure over northwestern ntario. Since these will move past ontreal in the same order, it can be ated that at a certain hour in the future ontreal will be experiencing showers llowed by a veering and increasing ind, a drop in temperature, and clearing ies. The time within an hour or so hen each of these will happen should predictable, as well as the amount of ange in wind or temperature. This count of the forecast process quite aturally has been highly simplified, and is just the points which have been nitted that bring the element of uncer-inty into the forecast.

This is a point which should be of con-derable interest to the engineer—that , what things can be forecast and what nnot. In popular literature there seems be two schools of thought on the matter. he older one—perhaps the result of sad xperience with forecasts in earlier days— that the weatherman is always wrong. he second swings to the other extreme nd believes that as result of recent de-elopments the modern meteorologist can recast nearly everything—can even tell ou in January whether it will rain Easter unday. The last opinion is probably artly the result of certain rosy pictures ainted in the popular press which also as given us plastic cars, a helicopter in very back yard, and every man with a 10,000 gadget-run house.

As usual the truth lies between these vo extremes. Weather forecasting does ot and cannot pretend to be 100 per cent ccurate. Though many notable ad-ances have been made in the last 25 ears, it is readily admitted that there are any problems and weather phenomena at have not yet received a satisfactory ientific explanation. Until this is done e cannot hope to forecast them on any asis except that of experience, which is ot very satisfactory.

Having admitted the darker side of the picture however, one must hasten to add that there is also a brighter side. Developments over the past quarter century have enabled us to go far beyond the older type of forecasts that perhaps read, "Partly cloudy, rain in places." This is particularly true of aviation forecasting, which has received very close attention in the past ten years, but it also applies to many elements affecting the engineer. It might be assumed, first, that it has been possible to foresee all the different changes that will take place on the weather map. This being the case the following can be done:

1. *Temperature.* The maximum temperature for a day and the general minimum for the night can be forecast within two or three degrees. "General minimum" is used because this temperature often is affected by very local conditions, such as proximity to bodies of water, or location on mountains or in valleys, which cannot be considered in detail in a forecast covering a large district. When these particular details are given, however, there is no reason why a good forecast cannot be made for one particular point. In the case of temperature changes it can be stated within an hour or so when the temperature will begin to rise or fall and the extent of the change.

2. *Humidity.* Under average conditions humidity can be forecast within about ten per cent in terms of relative humidity or four degrees in terms of dew points.

3. *Wind.* Moderate or strong winds can be forecast quite accurately both as to direction and speed for an exposed location. If the location is sheltered in any way, however, by hills or trees or other obstacles, the velocity and speed may be very different. In such case a special study would have to be made of each such point to determine the local effects. The winds mentioned here are general winds which prevail over a large area. In addition there are local winds produced by small storm areas such as thunderstorms or small tornadoes. About the most that can be attempted with such winds is to indicate the possibility that they will occur. There is very little hope that the exact area or time can be named, or that the different wind directions can be foretold fully until the storm has actually developed.*

4. *Degree of Cloudiness.* This usually can be foretold within three-tenths or four-tenths and often much closer. The thickness of the cloud also can be indicated with a good degree of accuracy.

5. *General Weather.* The time within the next 72 hours when rain or snow should start or stop can be forecast. The total amount of rainfall or snowfall during any storm is somewhat more difficult, but if they are forecast on a basis of light, moderate, or heavy they should be right about 80 per cent of the time.

6. *Freezing Rain.* To this element, very important to the electrical engineer, the same remarks apply except that this depends also on the temperature forecast, and, when the temperature hovers around 32, this must be quite accurate indeed. Canadian experience has been that in 80–85 per cent of the cases it was possible to provide previous warning of freezing rain or sleet conditions.

7. *Thunderstorms.* The time when thunderstorms are likely to occur over a certain area can be indicated, but predictions on where individual storms will occur or the paths they will follow cannot be attempted. It may be easier to realize why if one thinks of a thunderstorm as a shot from a gun. One can give warning when the gun is fully loaded and likely to go off, but there are so many small local conditions that may or may not pull the trigger, that it is impossible to say just where the shot will occur. The same can be said of local showers as distinguished from general rainfall.

It will be seen from this account that an accurate forecast of the weather features most important to the engineer can be given over a general area. It must be admitted that there may be local variations from this forecast which it would be impossible to detail without destroying the value of the forecast, but it will be found that this is still a great advance over the present system of operations entailing no knowledge of future weather conditions.

All this has assumed that it has been possible to foresee all developments on the weather map. Most of the time this will be the case, but it is possible that on rare occasions there may be sudden developments which it was difficult to foresee that were not shown on the last weather map. These are usually the cause of the small number of forecasts which are incorrect, and one of the problems which meteorologists now are attempting to solve is how to foresee these sudden developments of new weather areas.

The matter of the range of forecasts is an absorbing one to the engineer and one which is even more important to the meteorologist. To state the case briefly it is the general opinion of meteorologists that no forecast of *reasonable* accuracy yet can be given for a period of more than four or five days, and no *detailed* forecast can be made for more than three days ahead. This problem perhaps has been confusing to those on the outside because of the number of claims advanced in recent years for long-range forecasting systems. In evaluating such systems two facts must be kept in mind. The first is that a straight guess as to the weather on any particular date should be right 50 per cent of the time. If, in making this guess, climatological averages are taken into account, the accuracy should be much better than that. For example, if you wish to know whether it will rain a week from today and if in addition you know that at this time of year it rains one day out of three, then the probability that you will be right if you say it will not rain is almost seven out of ten. Any other system of long-range forecasting must, therefore, be able to exceed this method to be of any real value. It is the considered opinion of those who have investigated most of the newer systems that they are no better than the system of climatological averages.

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* Present experiments with radar offer some hope that it may be possible to locate and chart the course of local rainstorms.

To sum up this article to this point it can be said that present-day meteorology is able to provide fairly accurate forecasts, up to three days ahead, of temperature, humidity, *general* wind direction and velocity, cloudiness, and precipitation, though with the latter the forecast of the actual occurrence is apt to be more accurate than the forecast of amounts. Forecasts of a more general nature up to five days now are being made in the United States, but beyond that period most meterologists feel that climatological statistics still provide the most reliable indication.

The remainder of this article will try to consider the weather problem from the electrical engineer's viewpoint. The effect of the weather on the electrical or power industry would seem to fall into four separate fields:

1. Effect on general outdoor operations.
2. Effect on electric equipment.
3. Effect on consumer demand for power.
4. Effect on water resources of hydroelectric power companies.

GENERAL OUTDOOR OPERATIONS

Both the power companies and the communications companies must carry on considerable outdoor operations at all seasons of the year, particularly on transmission and communication lines. It is hardly necessary to indicate to engineers that such operations are dependent to a great extent upon the weather. The mere fact that most major operations are planned for the months of best weather should indicate this. The weather not only affects the comfort of the employees, but at certain times it makes outdoor activities almost impossible.

The winter snowstorms in Quebec, for example, often result in blocked roads for several days at a time. In general such outdoor activities will be affected by snow or rain, high winds, and low or high temperature. From what has been said previously it will be seen that these factors can be forecast quite satisfactorily for two days ahead. Outdoor operations then can be planned with fair certainty that far in advance. This side of the matter, however, is one of the most familiar, and it is the other effects, which most often are overlooked.

EFFECTS OF WEATHER ON ELECTRIC EQUIPMENT

The effect of weather on electric equipment also should be apparent to the electrical engineer. Perhaps the most noticeable effect here is that on transmission and communication lines. Glaze storms can result in damage running into hundreds of thousands of dollars. In the case of transmission lines some of this damage may be avoided by warming the conductors internally. This very often requires some advance notice, however, especially where it will require rerouting of loads. These measures are not possible on communication lines, but the length of interruptions to service could be reduced greatly, if it were possible to prepare for such storms ahead of hand. The question in the engineer's mind seems to be whether such warnings of a reliable nature can be issued. As has been pointed out earlier, weather science does not pretend to be perfectly accurate at present, but on warnings such as glaze storms a high degree of accuracy can be attained. Generally it can be stated within an hour or two when the glaze can be expected to start, when it is likely to end, its general intensity, and the conditions following the storm, that is, whether it is likely to be followed by rising temperatures—which would cause the ice to melt—or falling temperatures and the strength of the wind following the storm—which can increase the damage by 100 to 200 per cent. It is quite probable that an occasional occurrence may not be foreseen, or that one case forecast may not happen, but this should not occur more than ten per cent of the time, and the general result still will be far ahead of the present method of sitting back and waiting for things to happen.

Mr. Davison of the Ontario Hydro-Electric Power Commission who wrote on this subject last year,[1] has given special attention to another effect of weather on transmission lines—that of galloping conductors. This is a problem requiring not a forecast but a series of meteorological records for analysis of wind gustiness. The same of course applies to the design of transmission lines and the establishment of standards. Sometimes it has even seemed that not sufficient attention has been paid to meteorological records in setting up such standards. In certain sections it almost would seem that the standards exceed what might be expected from meteorological data, whereas in others the reverse is true. During the past ten years, for example, many additional meteorological stations have been established in Canada, especially in the more northerly sections. It is general experience that the more serious sleet or glaze storms are confined to Southern Ontario, the upper St. Lawrence valley, and the Maritimes, and that north of this belt the frequency of such storms is very low. The data to determine this should soon be available, and, if such be the case, it might be a factor in altering present standards.

Lightning is another factor affecting electric equipment. I already have indicated fairly well just how much aid the meteorologist can give in this problem. The general areas in which storms are likely to occur can be indicated, as well as the times in which such storms will occur. These can be indicated as much as 48 hours ahead. The actual location and path of such storms is another probler
It would appear from studies made
other countries that thunderstorms ha
a tendency to follow certain paths, d
pending probably on the conductivi
and the topography of the ground.
such studies yet have been made
Canada, but valuable knowledge mig
be gained if they were.

Another point affecting the operatio
of electric equipment is that of atmospher
humidity. This is perhaps most notic
able in telephone equipment and in t
manufacture of insulated cable. T
problem here is quite simple from
meteorologist's point of view. Humidi
can be forecast to a high degree of accura
up to 48 hours ahead.

The points which I have mentione
where weather affects electric equipme
have been only the most apparent on
and have been mentioned only as exampl
of what help can be given. There a
many other effects, but determining the
is actually the task of the engineer and n
the meteorologist.

EFFECT ON CONSUMER DEMAND FOR POWE

This is a problem which has receive
considerable attention from certain uti
ties in the United States. The demand f
power will be influenced by the brightne
of the day, and by the "effective temper
ture." The brightness of the day w
depend in turn on the time of year, whic
governs the maximum altitude of the su
the visibility or transparency of the a
mosphere, and most of all on the clou
cover. It is not sufficient to know t
amount of cloud only, but its thickne
also must be known. The "effecti
temperature" is the controlling factor
the demand for power for heating-
perhaps not so important in these region
By "effective temperature" is meant
combination of temperature, wind velo
ity, and humidity, all of which combi
to determine the amount of heat requir
to heat any given space. The theor
then, is that if the distributing compa
has a reliable forecast of cloud cove
visibility, temperature, wind and humidi
its engineers should be able to foreca
the variation in power consumption f
lighting and heating. To put such for
casts into actual use it would be necessa
to make a study of the variation of pow
consumption under different weath
conditions and then to base further for
casts on this past experience.

The procedure mentioned here is n
a hypothetical one, but one which h
been put into practice by several pub
utilities in the United States. Very co
siderable success has been achieved
forecasting power demands for 24 hou
ahead. It is notable, however, that
achieve this success these companies fou
it necessary to employ their own mete
ologists and to install teletype drops to t
meteorological teletype circuits.

FECT ON THE WATER RESOURCES OF HYDROELECTRIC POWER COMPANIES

One of the major concerns of the hydro-ectric power companies is the main-nance of sufficient water reserves and e economical use of such reserves. This s been especially important during the st two years when it has been necessary run near full capacity. Sufficient water serves must be accumulated during the etter seasons to carry over the drier rts of the year. At the same time e company will not realize its maximum come, if too much water is being held reserve when the dry season ends. he same problem applies in short-term anagement. If the times and amounts precipitation could be known before-and, then an equal amount probably uld be withdrawn from reserves at a me when the need is probably greatest.

At the present time forecasting can be only limited help with the first of these roblems, which we might call long-term anagement. What is actually needed a reliable seasonal forecast which will ate, for example, at the beginning of the mmer whether precipitation will be ove or below normal for the summer ason and just when the wet fall weather ill start. Although a great deal of atten-on is being paid to research on long-ange forecasting, and in spite of the claims ade for a number of systems, it is be-eved that no satisfactory method of mak-g such forecasts yet exists.

In that case the alternative is to work om climatological records. Such figures ill indicate the maximum, minimum, and verage precipitation for the drainage rea, and it will be necessary for the ngineer to calculate on this basis. As a sult of the war and the establishment of large number of extra meteorological porting stations, it can be anticipated at much better precipitation records on will be available, especially for the ore remote sections which previously ere poorly covered.

Forecasting can prove of much more ssistance in short-term management. recipitation amounts are rather difficult forecast, particularly in the case of owers and thunderstorms where the mounts may vary an inch or more in a w miles, but such forecasts still are of fficient accuracy to make them quite aluable. A forecast of rainfall or snow-ll amounts is much more accurate in the ase of storms covering large areas, and it these which produce the major part of e annual total.

The problem of water reserves, however, not solved even when the precipitation known. All precipitation will be ivided between evaporation and runoff $P=R+E$) and theoretically before one ould determine the runoff from any given mount of precipitation, it would be ecessary to determine the evaporation rm. Until recently it has been impossible to measure evaporation next to land surfaces. Studies in aerodynamics, however, now have yielded information on the structure and characteristics of the air near the ground, and this is permitting us to develop a technique for measuring evaporation from natural surfaces. When such data becomes available it then should be possible to measure each of the three terms in the hydrologic cycle. Without such data, however, it is still possible to establish an empirical relationship between precipitation and runoff, based on past experience. Though the ratio of the two will depend on a number of factors such as the character and moisture content of the soil, intensity of the rainfall, temperature, the state of vegetation, and so forth, it should be possible to obtain an approximate ratio of the two for an entire drainage area. This ratio of course must be varied to suit changing conditions as previously outlined, and frequently during a heavy storm the runoff factor will vary from hour to hour.

The procedure followed by the United States flood forecasting service might be of interest as an illustration of what is necessary to predict stream levels. In setting up such a forecasting service it first was found necessary to have a complete network of stations reporting precipitation and river stages together with snow and ground-surface conditions, and to provide a comprehensive network of telephone, telegraph, or radio communications to bring these to a central point. These observations then pass into the hands of a competent forecaster who must have expert training in meteorology as well as in flood forecasting. The forecast of future flood stages then is reached by a combination of all available information. This information includes

(*a*). Past precipitation measurements.

(*b*). Present river stage readings.

(*c*). Forecasts of future precipitaton.

(*d*). Data with regard to the runoff coefficient as shown by research and past experience.

The variation of this last factor under many different conditions and types of soil has been the subject of considerable study. In reaching the actual forecast the procedure varies. On the lower reaches of larger rivers the forecast will be based chiefly on readings from gauging stations upstream. In headwater regions the forecaster must go beyond upstream river stages and take account of forecasted rainfall, infiltration capacity of the soil, runoff from melting snow and the physiographic characteristics of his basin. The stream discharge from tributaries whose watersheds have been selected as typical of the entire basin may be used as a guide.

This system probably would prove too expensive to be undertaken by any private corporation, but it contains a number of suggestions on how present methods of water-level prediction could be improved.

Meteorology can be of increasing use to the electrical engineer, if continued effort and study are applied to the matter. I have already outlined what can be done at the present time, but the fact remains that many companies are making only limited use of this knowledge. This may be partly due to a lack of knowledge of the subject on the part of the engineer. The increased use and publicity which meteorology now is receiving, as well as talks of the present nature, should help to remedy this. Other engineers have taken up the subject with expectations which were not warranted by present development of the science. They perhaps have expected that they might receive precipitation forecasts for weeks in advance or be advised ahead of time of all thunderstorms affecting their power systems. That such information cannot be supplied should not mean that the engineer can lose interest in the matter. There is still available a large mass of information which I already have indicated, and a study should be made of the ways this can be applied to his work.

Certain other problems should be made the subject of further study either by the electrical industry or by the Canadian Meteorological Service. The path of thunderstorms in a district is one. The investigation of the matter of cycles is another. Still another is the incidence of glaze storms over certain districts, especially with a view to the topography of the district.

There are also certain improvements which might be made in the service being supplied the electrical engineer. It would be an advantage if there were regular radio broadcasts of expected weather over local stations, such broadcasts to be much more detailed than those now being supplied. In some countries regular snow surveys have been undertaken by the meteorological services. So far in Canada this work has not been organized in a really efficient manner, part being done by private companies and part by other government services whose concern in the matter is rather indirect. An increased staff is required by the Canadian Meteorological Service to serve industrial companies and general forecasting. Most of this service now is being supplied by a staff which was set up to serve aviation alone. A larger staff would be able to supply more frequent and more detailed forecasts and to keep all concerned advised of any sudden developments.

The electrical companies themselves can help to improve the accuracy of forecasts by furnishing the meteorologist with all weather observations made over their own systems. Such an arrangement has been operating for some time between the Canadian Service and the Shawinigan Water and Power Company, and the observations have been of great value in improving the accuracy of forecasts.

If an electrical company is to make full and efficient use of weather information, it should demand that the personnel who are handling this information have a sound knowledge of the basic principles of meteorology, and many United States companies have found that it paid to have an expert on their staffs.

We are very hopeful that a number of improvements will come out of the research being carried on during the present war. Radar might enable quick observations of different layers in the atmosphere. Possibly some of the long-range forecasting systems may be able to prove its worth.

The improvements to be effected by the meteorologists depend to a great extent upon the demand made by those who need their services. Money and personnel must be supplied by the government, and this will be done only in proportion to nee shown.

There is no doubt that, given the mone and the personnel, the meteorologist coul solve many of the weather problems no affecting the electrical engineer.

REFERENCE

1. Meteorological Service for Electric-Power System A. E. Davison. *Electrical Engineering*, volume 63, Ju 1944, page 203–09.

Electrical Essays for Recreation

The following essays are presented for the recreation of the reader. The author's challenge to the reader is: Can you find the error in the reasoning accompanying the various examples?

D-C GENERATOR WITHOUT SLIDING CONTACTS

Figure 1 shows a core with an air gap B. A wire C is bent into the shape of the letter U and placed in the gap as shown. The wire is caused to swing backward and foreward in the air gap. This means that the leads to the wire are flexible but there is no complete rotation that would require a sliding contact as is found in the slip rings of homopolar generators and in the commutators of multipolar generators.

The wire is vibrated so that it crosses the gap with a velocity given by

$$v = V \sin \omega t \qquad (1)$$

At the same time the current in the coil wound on the core is varied so that the flux density in the air gap is given by

$$b = B \sin \omega t \qquad (2)$$

Now the formula for the voltage induced in a wire cutting a magnetic field is

$$e = bvh \qquad (3)$$

where e is the instantaneous voltage, b the flux density, v the velocity, and h the length of the wire in the field. We have on substituting equations 1 and 2 into equation 3

$$e = BVh \sin^2 \omega t \qquad (4)$$

Equation 4 can be rewritten, using the trigonometric identity,

$$\sin^2 a = {}^1/_2 - {}^1/_2 \cos 2a \qquad (5)$$

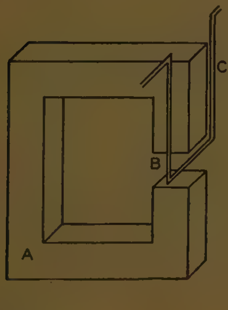

Figure 1

as

$$e = \frac{BVh}{2} - \frac{BVh}{2} \cos 2\omega t \qquad (6)$$

A filter similar to that found in the rectifier voltage-supply of a radio set can be connected to the flexible leads and the double-frequency term in equation 6 will be eliminated. This leaves the constant term and we have a direct-current generator using no sliding contacts.

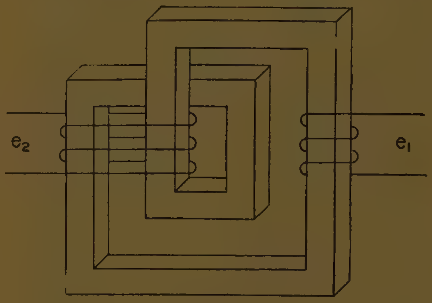

Figure 2

A TWO-TO-ONE VOLTAGE-RATIO TRANSFORMER WITH ONE-TO-ONE TURN RATIO

This transformer is shown schematically in Figure 2. The coils shown have three turns but any number can be used. If both coils have the same number of turns, then neglecting leakage

$$\frac{e_2}{e_1} = 2 \qquad (7)$$

This may be shown as follows. Assume that the flux in the core in the coil on the right is ϕ. Then the flux in the coil on the left will be 2ϕ since the core passes through this coil twice. The voltage induced in the right-hand coil is

$$e_1 = N_1 \frac{d\phi}{dt} \qquad (8)$$

The voltage induced in the left-hand coil is

$$e_2 = N_2 \frac{d(2\phi)}{dt} = 2N_2 \frac{d\phi}{dt} \qquad (9)$$

Therefore if $N_1 = N_2$

$$\frac{e_2}{e_1} = 2 \qquad (10$$

as stated herein.

POWER-FACTOR PARADOX

Consider the ten-ampere current wav shown in Figure 3a. The amplitude i 14.14 amperes. Suppose that a rectifie is used to pass the upper half of the sin wave as shown in Figure 3b. The effectiv current is now five amperes. If this cur rent is passed through a one ohm resisto the power computed from the formula

$$p = Ri^2 \qquad (11$$

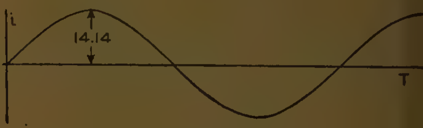

Figure 3a

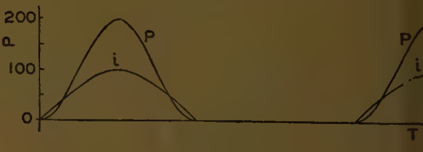

Figure 3b

will be a wave as indicated in Figure 3b It has a maximum equal to 200 watt and a minimum equal to zero. The powe wave is a double-frequency sine wave dis placed from the axis by an amount equa to the amplitude. Therefore the averag value of the power wave is 100 watts Since there is no current half of the tim the true average power is only 50 watts.

The effective current is five ampere This passing through a one-ohm resistanc produces an effective voltage drop of fiv volts. Therefore the volt-amperes fo the circuit is 25, the power is 50 watt hence the power-factor is 2.

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Scientific Truths and Their Use by Society

FREDRICK T. ADDICOTT

This article clarifies the responsibility of the scientist and engineer in the modern world, and emphasizes the obligations of society to utilize the researches of science for the common good.

CRITICISM frequently has been raised that scientists and engineers are as much responsible for the evils of civilization and the horrors of war as they are for the good arising from their contributions to our present state of technical advancement. The implication of this criticism is that they should either limit the breadth of their activities or guide the application of their work so that the results could not possibly be misused. The object of this article is to make two points:

1. There is no valid basis for such criticisms.
2. A scientist has certain obligations which, if met, discharge his responsibilities to society.

The fallacy of the idea that a scientist or engineer might be able to predetermine all of the ultimate uses to which the results of his efforts might be put is self-evident. In addition, it could be argued extensively and successfully that the good arising from the results of scientific effort has far exceeded the evil. But in a larger sense science is responsible for neither. The principal concern of science is to add to our knowledge. It should not be considered primarily responsible for the use society makes of that knowledge. Engineers show how scientific achievements may be applied, and likewise engineers cannot be held responsible when society directs these applications into destructive channels. Ultimately it is the option of society to approve or reject the utilization of scientific advancements. Many cases are on record in which society has permitted the withholding of technical developments, even though they were of obvious benefit. Is it not then equally the option and obligation of society to reject such applications as would appear detrimental to the common good?

The duty of the scientist is to search for truth disinterestedly and to present his findings without prejudice. The duty of the engineer is to devise useful applications of these scientific findings. (Many scientists and engineers perform both functions.) One of the principal duties of the students of social problems should be to examine and recommend the best utilization of the advancements of science. Such a division of responsibility is inherent in the complexity of this civilization. An advance of real worth may require the close co-operation and undivided attention of many scientists and engineers. The achievement of maximum benefits from an outstanding discovery, however, requires, in addition, the full co-operation of those concerned with social problems. The final responsibility for the ends to which knowledge is utilized rests upon this latter group, and not upon the scientists who discover truth or the engineers who show its applications.

This division of duties does not mean that the scientist and the engineer are free to ignore their fellow men in the pursuit of their technical interests; they have obligations to their calling and to society which cannot be ignored.

First and most important is the obligation to adhere to the scientific method. One should never let the value of his fine training be dissipated by permitting scientific principles to come second to personal impulse. The scientist or engineer must constantly re-examine himself and his work, and keep both in line with the most rigorous scientific precepts. Only by so doing can he be sure that his efforts will result in real and lasting contributions.

Second, the scientist or engineer must conscientiously instruct those who come under his tutelage, whether they be students or associates. Instruction should be given in the scientific method as well as in established knowledge. It is essential to the maintenance of the present civilization and to future progress that the scientific method be passed on to the coming generations. As new facts become known the worker in a scientific field should add them to his personal store of knowledge, then these facts should be sifted carefully and passed on to students and associates so that they may have a sound foundation upon which to build the advancements that accrue in their lifetimes.

Third, the scientist and especially the engineer have the obligation to indicate clearly to society what good they believe might be achieved from their contributions. This is an obligation which should not be overlooked. Although the needs of society are not fully known, something is known of the possible value of the work of the scientist and the engineer, and where possible the first steps should be taken towards its full utilization.

It is possible that many would wish to modify these suggestions. It might be valuable to amplify or extend them. However, if this brief discussion stimulates the reader to consider his relations to society and the obligations they impose, the writing of this note will have been well justified. If the scientist and the engineer should acknowledge these three obligations:

1. To rigorously adhere to the scientific method.
2. To instruct conscientiously those who come under their guidance.
3. To indicate clearly to society what benefits might accrue from their contributions.

and conscientiously attempt to fulfill them, they are worthy of a respected place in society. After the engineer or scientist has done his part, it is the duty of those who guide society to see that means are available for the utilization of the achievements of science and engineering for the highest good.

Based on article, "The Obligations of a Scientist" published in *Science*, September 22, 1944.

Fredrick T. Addicott is assistant professor of botany at the Santa Barbara College of the University of California, Santa Barbara, Calif.

Engineer's Role in Postwar World

THE sales engineer is the man of the hour—so concluded L. C. Welch, a director and general manager, lubricating and sales technical-service departments of the Standard Oil Company of Indiana, in an address recently delivered before the Engineering Society of Detroit Rackham Education Memorial. Mr. Welch's topic was "Engineering Salesmanship and Engineering Training" in which he developed the role of the graduate engineer from the days when he was a highly technical man with little or no interest in selling himself or any product to the advent of the engineering era and the industrial advance of the postwar years.

Mr. Welch predicted that the engineer salesman will become a necessity in many industries in the world of the future; that many industrial concerns, in an effort to develop rapidly capable talent of this character will initiate, reinstate, or extend training courses where selected graduate engineers, with and without sales experience, will receive intensified instruction, combining laboratory and theoretical training, with practical application in plant, factory, and refinery. The men necessary to meet the demands of the future will be found among the well-grounded well-qualified sales engineers, trained in basic engineering, and in the understanding of technical and practical problems of customers.

A Survey of Co-operative Councils

FRANK E. SANFORD
MEMBER AIEE

This historical sketch of the growth of local councils of engineering and technical societies brings developments of the movement up to date. In this review the author gives some valuable information on the present status of these councils in the United States, and encourages scientific men to formulate co-operative plans and arrangements for the interchange of their highly specialized knowledge and the spreading of technological advances.

FORMATION of local councils of engineering, technical, architectural, and scientific societies is a movement that is rapidly gaining strength across the country. Provision of a medium for co-operative action among local sections of national societies and local clubs or societies of engineers is the principal purpose of these council organizations. New individual memberships are not involved, but members of all constituent groups are members of the council through affiliation of their organization.

Local conditions and purposes have governed the arrangements made, and in general there has been no outline or guidance on a national scale. Local committees planning councils have often sought some suggestions from a few other cities but, so far as we have been able to learn, no general review has been made of the various arrangements in use. The Cincinnati Council sponsored this survey of co-operative plans in other cities, in recognition of its own tenth year of operation.

Our broad purpose is to make available to other similar groups, the suggestions and encouragement that such a review may bring as well as to seek possible ideas for extensions or improvements in our own plan. Knowledge of the plans and experiences of others may be helpful to those who are starting and experimenting. It may also be an inspiration to still other groups to start, or to expand co-operative arrangements.

SCOPE OF ORGANIZATIONS

Information from 35 local organizations has been reviewed in this survey. About 400 local sections and societies and 100,000 individual members are represented in the councils or affiliate arrangements.

Four of these co-operative council plans have been in operation 25 years or more. Six more were added by 1930, 11 in the period 1934 to 1939, and ten since 1940. Of the latter, five councils were started last year. Four additional councils are now being organized.

Since the primary purpose of this report is to present ideas that may be helpful and suggestive, some of the outstanding activities have been noted rather than details of each council. A tabulation of size, member organizations, and other data was prepared, but it does not appear as useful as the more pertinent information derived from a review on this broader basis.

Two Founder societies, AIEE and the American Society of Mechanical Engineers, are in every council of the survey, with a third, American Society of Civil Engineers, missing in only five cases. A professional engineers' society, most frequently a chapter of National Society Professional Engineers, is listed in two thirds of the reports.

Excepting in four cities, the average council includes ten member societies—four with 15 to 17 members, four with five or six, and the majority with 8 to 12 societies. Cleveland and Chicago with 33 societies, Detroit with 28, and Pittsburgh with 25, cover a much broader scope of organization than this average.

OUTLINE OF PURPOSES

Co-operative action by the member societies on matters which are beyond the scope of the individual organizations is the primary purpose stated. A means is provided on a broad scale to promote the public welfare whenever technical, engineering, and scientific knowledge and experience are involved or can be useful.

Another definition states, "for co-operative effort in increasing the scope and availability of the individual organizations; to promote, co-ordinate, and integrate inter-organization activities and good-will; to publish a bulletin; to encourage interest and participation in civic affairs."

Provisions are made for: vocational guidance for technical students, co-ordination of program activities, encouragement of joint meetings between two or more societies. Annual joint meetings of all societies are arranged by several councils. Co-ordination is a stated purpose, but there is no direct jurisdiction over the meetings or actions of the constituent societies.

Several councils have been organized in connection with, or as a result of, war activities. Two council reports state that "the organization is a natural development from the organization of societies which sponsored the War Production Clinic." Another followed a temporary arrangement to consider postwar planning problems. It was felt desirable that the engineers be represented in future action and be organized to offer their assistance and advice in the solution of such problems.

PLANS OF ORGANIZATION

In all of the council plans reviewed, the affairs are administered by two representatives or delegates, or by one delegate and an alternate, from each society. They are usually regular officers of the member society or, in a few cases, they are appointed for the council. Meetings of the council, governing committee, or board are held three or four times each year, or annually and as called by the chairman.

Perhaps the organization plans can be classified into three broad groups or types, although the lines of separation in type are not sharp.

1. A local engineers club or society sponsors local section affiliation or participation in a council. Joint memberships are encouraged by several local societies, by a reduction in dues for members of affiliated societies.

2. Local sections have organized the council, usually with a local club participating as one of the members.

3. A combination of the two plans appears in a few cases, including our Cincinnati Council. The local society and local sections of national societies are members of the council, with the local society performing certain services for the council.

NOTES OF ACTIVITIES

The following notes of activities may not do justice to many of the councils. The aim has been to select an outstanding point about each, and in this I could easily be in error because of lack of familiarity with the individual group.

Since 1916, The Engineers' Club of Baltimore has sponsored a plan of affiliation, providing local headquarters, meeting rooms, and services for which each society pays annual dues for its members who are not also members of the club. A closely knit association has resulted for interest in civic and technical matters in the city.

Joint Council of the Associated Engineering Societies of St. Louis is composed of representatives from the Engineers' Club of St. Louis and from each local section of a national engineering society holding membership in the council. Joint Council has, since 1914, taken an active interest in civic affairs such as furnishing aggressive assistance in the formation and adoption of a new smoke ordi-

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Essential substance of an article in *The Engineer and Scientist,* April 16, 1945.

Frank E. Sanford is distribution engineer, the Cincinnati Gas and Electric Company, Cincinnati, Ohio, and is director for publications, The Technical and Scientific Council of Cincinnati.

nance, framing examinations for civil service, writing a new building code, and in recommending appointments to prominent technical positions. They do not have a publication or joint notice for societies' meetings.

Affiliated Technical Societies of Boston, organized in 1922, has grown from 9 to 15 affiliated societies and is now organized as the Engineering Societies of New England. Co-operating also are 8 allied organizations in other cities. An outstanding activity is industrial co-operation with various manufacturers' associations and Chambers of Commerce in the area. Other committees are to provide counsel and assistance for young engineers, for public affairs and for employment service. Outstanding engineers are recognized by an annual New England Award. A weekly paper carries notices of all affiliated society meetings.

A record of civic and professional affairs interest that seems to be unsurpassed by any other council appears in the reports of the Connecticut Technical Council (New Haven). The state engineering registration board, appointed by the governor, is largely from the recommendations of council. Several other commissions and board appointments where engineering qualifications are desirable are similarly made from lists submitted by the council. Programs of vocational guidance, civic planning, and co-operation with war-industry conferences have received active attention. Publication of a bulletin has recently been started, with distribution to members of all societies.

The Florida Engineering Council has representatives of the Florida Engineering Society and of local sections and local organizations to act as a co-ordinating committee for all engineers and for engineering problems of the state.

Four local engineers clubs, two state associations, and three local sections of national societies co-operate in the Minnesota Federation of Engineering Societies. This state-wide organization, with headquarters in St. Paul, has taken an active interest in bond issues, and codes, and in submitting lists of qualified members to state boards.

The Worcester Engineering Society is made up of six affiliated societies, who have voted their entire membership into the society. By such action, the affiliate "shall not forfeit its own individual identity and it shall continue to follow its own methods of action. . . ." Individual memberships are also provided in the society for those who are not members of an affiliated society.

Local sections of four national technical societies are affiliated with the Rochester Engineering Society. The club rooms are furnished for meetings, and secretarial and office service are provided for business affairs of all societies. The *Rochester Engineer* is sent monthly to all members of the societies, and the cost for all services is on a per member basis.

A somewhat similar plan is followed by the Providence Engineering Society. Each technical organization may hold its meeting in the society's auditorium, and a weekly meeting announcement bulletin is sent to all members of all affiliated societies. The chairman of each local section meets with the Engineering Society Council.

The Engineers' Club of Birmingham furnishes office service for technical societies in the Engineering Council. Separate notices of society meetings are mailed by the club office. The chairman of Engineering Council serves on the board of the club.

Organized in 1943, The Chicago Technical Societies Council would seem to have undisputed place as the largest organization of this kind. It grew from a temporary committee to assist in the WPB War Production Clinic, and it now has 33 societies with 16,000 members. A monthly calendar of all meetings is sent to all members.

The Cleveland Technical Societies Council publishes *Cleveland Engineering* for its 33 member societies. This weekly was formerly the publication of The Cleveland Engineering Society, a member of council. It carries notices of all meetings to 10,000 individual members of the societies.

Annual joint meetings of all the member societies are important features of several councils, and other joint meetings of two or more societies are frequently arranged in most councils.

Seven joint or general meetings were held in the past year by the Schenectady Engineering Council. This group also has committees active in technical and vocational education and community planning.

Colorado Engineering Council (Denver) celebrated its 25th anniversary at its annual reunion in December 1944. A committee is now preparing a history and review of its activities.

Three joint general meetings, each sponsored by a member society, are a feature of The Toledo Technical Council. At a recent council general meeting there were 600 engineers and architects present of a combined membership of 900. A novel arrangement is the publication in a local newspaper of a column of council society news and notices.

An annual dinner meeting of Oregon Technical Council (Portland) was discontinued during the war. Plans of the Affiliated Engineering and Allied Societies in Ontario (Toronto) to hold an annual joint meeting of all societies were delayed by the war.

Ten annual joint general meetings with speakers of national prominence have marked the years of our Cincinnati Council. Our weekly publication serves as a medium for announcing programs to all of the individual members of societies in council and an annual directory lists all committees and a roster of members. The Engineering Society is publishing agent and maintains the membership and financial records.

Three cities in Indiana have councils. Co-operation of three local sections in several activities led to formation of The Engineers' Club of the St. Joseph Valley in South Bend. They are active in postwar planning, in an airport location and are now planning an industrial exhibit. A monthly magazine goes to all members of the co-operating societies. Local sections of four societies co-operate with the Fort Wayne Engineers Club in a civic affairs committee. Their *Engineers' News* is one of the best papers sent to me in this survey. Co-ordination and secretarial services for the Indianapolis Technical Societies Council are furnished by the Chamber of Commerce Industrial Branch. A monthly bulletin to be sent to all members is planned by this newly organized group.

Several large industrial centers have similar local society affiliation arrangements to facilitate co-operation in matters of common interest. The Engineering Society of Detroit and the Engineers' Society of Western Pennsylvania in Pittsburgh, each publish a calendar of affiliated technical society meetings and have arrangements for use of their auditoriums by these societies.

In Philadelphia, the Engineers' Club co-operates with local sections through an Affiliated Societies Council. The Engineers' Society of Milwaukee has plans for greatly expanding its own activities and is working toward a closer affiliation arrangement with other local societies.

The weekly publication of the Technical Club of Dallas carries all meeting notices to members of local sections affiliated with the club. Each society pays the cost of mailing for its members.

Local sections in San Francisco have an Engineering Council, with many features similar to the arrangements in Cincinnati. The District of Columbia Council is not as actively organized but it is ready to report on any question referred to it by a member organization. A joint notice bulletin was formerly published, but was discontinued several years ago.

The Louisville *Engineer and Scientist* was started on its publication schedule in December 1944. Ten member societies comprise the original group in the Council. The start they have made should be an inspiration to every similar group.

Two other widely separated groups are at similar stages of council development. The Puget Sound Council in Seattle and the Columbus Technical Council are aiming toward co-operative action. Columbus expects to start its publication in May.

A committee representing nine societies is planning for a reorganization of the Engineering Foundation of Buffalo to be more along lines of other council arrangements. A council is being organized in Kansas City. A monthly calendar sheet is to be sent with regular meeting notices of member societies until a bulletin can be arranged. The Engineers' Club of Tulsa is planning an affiliated council and expects that this review may be an added incentive in their efforts.

A constitution is ready for adoption by the local sections and the Engineers' Club of Dayton. This is along lines of the Cleveland and Cincinnati plans. A joint publication is expected as an early activity.

PUBLICATIONS

Publication of a monthly or weekly bulletin or magazine is one of the most desirable regular activies of a council. Regardless of the extent of other aims and objectives, it is essential that news and information of local interest to engineers should be carried to all the members in the local societies.

Monthly publications are used in a majority of the cases reviewed. A calendar of meeting and program announcements may be included, but apparently this medium is not as widely used as it might be. One or two reports noted that notices were sent out to their members by the individual societies, in addition to the notice in the publication.

Weekly publications, as in Cleveland, Cincinnati, Providence, and some others, serve for the meeting notices. In a number of the cities, the council publication is sent only to officers who are interested in co-ordinating activities, but interest in a general paper is indicated by several reports where this is now the practice.

Advertising is included in about half the publications received in this survey. This is notably true in Chicago, Cleveland, and Schenectady, where it is stated that the Council has no publication expense. Louisville expects to reach a self-sustaining basis also. Costs per member for other publications are noted at 40 or 50 cents per year for both weekly papers and the larger monthly magazines. These subscriptions are apparently always paid by the local section as its cost in the council.

In this connection, it should be noted that there is no better advertising medium to reach the engineers, architects, and specification writers of a local area than that afforded by a small local-interest publication. Equipment, tools, supplies, materials and services are being requisitioned or purchased daily by a large percentage of engineering-publication readers.

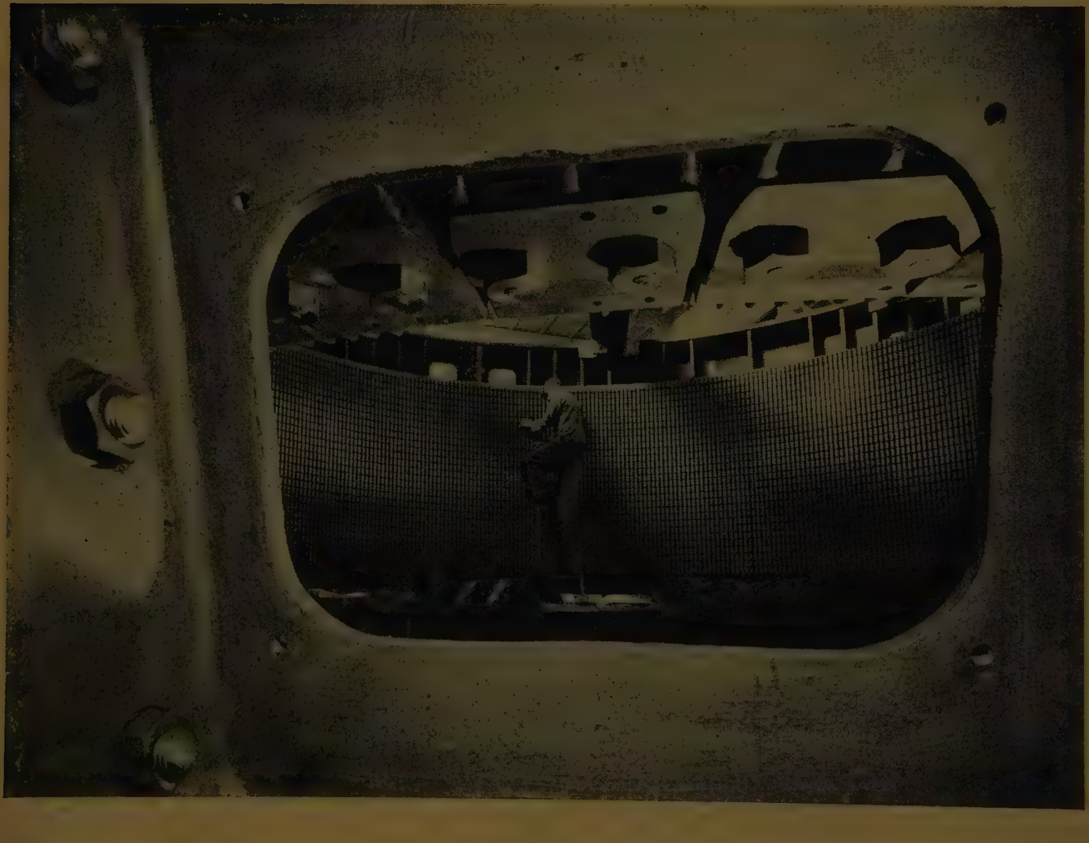
ACKNOWLEDGMENT

This very brief review is based on much more complete information received from the chairman or secretary of each group, and it was possible only because of their interest and help. To them we extend thanks and best wishes. Copies of this issue of *The Engineer and Scientist* are being sent to all the contributors, and additional copies are available for further distribution to committee members of societies and councils who may be interested.

The national boards of societies co-operating in the Engineers Council for Professional Development have endorsed proposals for joint activity of local units. The ECPD pamphlet "Will You Help?" points to a future possibility for broader co-operation. They clearly recognize that further development for joint action depends on local growth, and we hope that this survey may be helpful to them.

Locating the right men to furnish the desired information proved rather difficult in some cities. Thanks for help in this direction are due Charles Lee and P. L. Alger and several local Section secretaries of AIEE.

Large Generator for Power Station in Switzerland



View of the stator laminations of a large generator, constructed by Brown Boveri and Company, Ltd., for the Rupperswil - Auenstein Power Station, through an opening in the stator frame.

Statistical Methods in Quality Control

III: Frequency Distribution for Setup Check of Process

Quickest method for checking parts within desired quality range, the various operations of the inspector, and the purpose of the obtainable data are discussed in this article.

WHEN a machine is first set up, or a process adjusted, to produce parts of a desired quality, it is necessary to make a quick check of the parts being produced to determine if they are within the quality range desired. It has been found that the "frequency distribution" offers the quickest method of making this check.

A relatively large sample of the parts being produced is taken. It is not necessary that the individual parts be taken in order of production, although this is desirable. However, it is absolutely necessary that all of the pieces in the sample be taken at essentially the same time, that is, there must not be any break in production and no pieces must be left out of the sample.

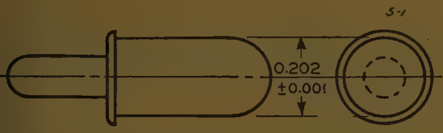


Figure 1. Phosphor-bronze rivet made at the rate of 120 per hour

The size of the sample will vary with various factors such as:

1. Difficulty of making the inspection.
2. Length of production cycle for each part.
3. Precision of the tools making the parts.

A sample of 100 pieces is about as large a sample as need be taken, and it is suggested that this be the size of sample taken, when practicable. It is rather important not to spread the time during which the sample is produced over too long a period. However, experience shows that a sample of from 25 to 50 pieces generally gives the data required for this initial analysis.

After the sample has been accumulated, the parts are inspected for the characteristics to be controlled. These might be dimensions, hardness, grain structure, color, or any other of the characteristics determining the quality of the parts. The parts may be inspected by the method of attributes, or of variables, as explained in a preceding article in this series.[1]

Briefly, inspection by the method of attributes means the classification of parts as good or bad. The measure of quality here is the "fraction defective"—the ratio of defective parts to total parts—and inspection by the method of variables means that the various characteristics to be controlled are measured, so that there is an absolute value of the quality of each characteristic. It is by the method of variables that the information is accumulated for making a proper frequency distribution of the particular characteristics in which the inspector is interested. A different distribution is made for each characteristic.

Consider the part shown in Figure 1. The machine has been adjusted by the machine setter to produce these parts within the required tolerances. The inspector approaches the machine and takes a sample of 50 parts produced one after the other. He makes sure that no parts, however obviously defective, are thrown away, except such parts as result from the end of the bar, and, therefore, are not considered normal production. The inspector then measures the diameter of the parts and records the data, as shown in Figure 2. This shows that the machine is producing parts over a wide range with a tendency to produce more parts near the lower specification limit. In this case this wide range might be due to an improperly ground tool or fouling of the cutting edge.

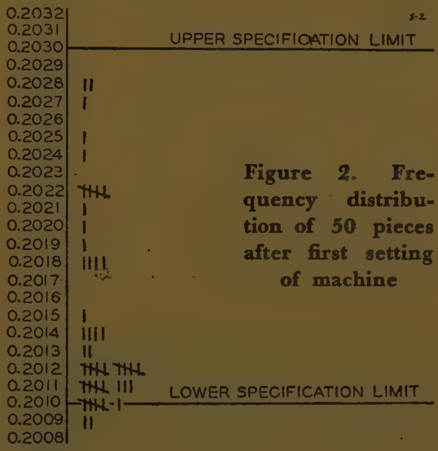


Figure 2. Frequency distribution of 50 pieces after first setting of machine

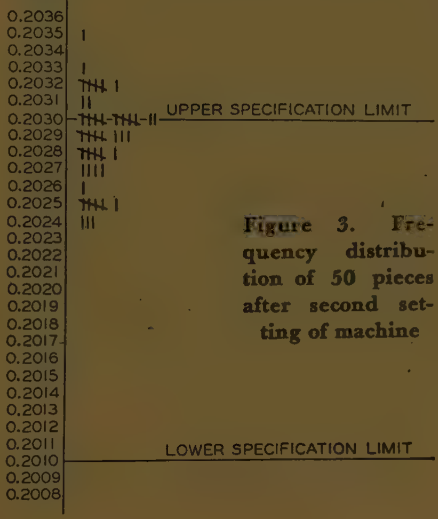


Figure 3. Frequency distribution of 50 pieces after second setting of machine

The tools must be sharpened and the cutting edges improved, so as to minimize the variability from part to part, that is, to decrease the band spread or range of the parts as produced. The information is furnished the tool-setter and he regrinds the cutting tools and resets the machine, after which another sample of 50 parts is taken and the parts again inspected. The data are recorded in Figure 3.

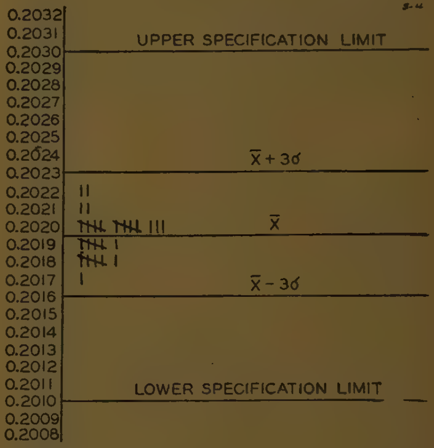


Figure 4. Frequency distribution and control chart after third setting of machine

This shows that the range has been reduced, that is, the variability from part to part is less than formerly. However, the tools are set toward the upper specification limit and parts are being produced which are too large. Tools are readjusted to bring the center of the distribution nearer the center of the specification limits.

The result, in the form of better operating conditions, is shown in Figure 4, based on a sample of 30 pieces. This indicates the operating condition of the machine at the time and proves the machine setup.

Once having obtained these data, it is possible to establish a continuing control of the job by means of the control chart, to be discussed in subsequent articles.

REFERENCES

1. Two Kinds of Measurement—Variables and Attributes. *Electrical Engineering*, volume 64, July 1945, pages 249–50.

2. Control Chart Method of Controlling Quality During Production ASA-Z 1.3 American Standards Association, 1942, New York, N. Y.

One of a series of articles prepared in the AIEE subcommittee on educational activities and sponsored by the AIEE subcommittee on statistical methods.

Personnel of the AIEE subcommittee on educational activities: J. Manuele, H. F. Dodge, A. I. Peterson, and R. E. Wareham.

INSTITUTE ACTIVITIES

Annual AIEE Meeting Held in New York—Items of Interest to Members

Because of the cancellation of the regular summer technical meeting the annual meeting of the AIEE was held in New York, N. Y., on June 27, 1945. Included on the agenda were the report of the board of directors by H. H. Henline (F '43), secretary, and the report of the treasurer, W. I. Slichter (F '12); also reports of the committee on tellers on votes for the proposed amendments to the constitution. Then followed the introduction of and presentation of the President's badge to Doctor W. E. Wickenden (F '39) and the latter's response. A report on the Institute prizes for papers was given by F. A. Cowan (M '29) chairman of the committee on award of Institute prizes and transmission engineer, operation and engineering department, American Telephone and Telegraph Company, New York, N. Y. An announcement was made of the election of Doctor C. E. Skinner (F '12) retired assistant director of engineering, Westinghouse Electric Corporation, East Pittsburgh, Pa., as an honorary member. (*EE, July '45, p 271*).

Another item of special interest to the membership was the presentation of the Lamme Medal to Doctor S. H. Mortensen (F '20), chief electrical engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and the latter's acceptance of the award. The program concluded with a review of the year's activities of the Institute by C. A. Powel (F '41), president.

The amendments to the Constitution were favorably voted upon by the membership. Hence, the following changes have been authorized.

1. Delete the word "national" from the titles of officers and the names of committees and meetings wherever that word is so used in the Constitution.

2. A Fellow shall be not less than 32 years old and shall qualify under one or more of paragraphs (*a*) to (*e*) of this section. To qualify under paragraphs (*a*), (*b*), or (*c*) he shall have been in good standing in the grade of Member for a period of at least five years immediately preceding the date of application for the grade of Fellow.

(*a*). An electrical engineer by profession. As such he shall be qualified to design and to take responsible charge of important electrical work; he shall have been in the active practice of his profession for at least ten years, and shall have had responsible charge of important electrical work for at least three years. When the applicant holds, in a principal national society of an allied branch of engineering, membership of a grade for which the qualifications indicate a standing equal to that required for the grade of Fellow herein, such membership shall be considered equivalent to five of the requisite ten years of active practice of the electrical profession.

(*b*). A professor of electrical engineering or of electrical science. As such he shall have attained special distinction as an expounder of the principles of electrical science and of electrical engineering; he shall have had at least ten years' experience as a teacher of electrical subjects, and shall have had responsible charge for three years, in an electrical course of a principal school of engineering. Any years of experience as defined in paragraph (*a*) that the applicant may have had as an electrical engineer shall be considered the equivalent of the same number of years of experience as "a teacher of electrical subjects."

(*c*). A person regularly engaged in electrical work for at least ten years, who by training, experience, and proficiency in electrical practice or theory has attained a standing in the profession equivalent to that required for Fellows under paragraph (*a*) or (*b*).

(*d*). A person who has done notable original work in electrical science of a character to give him a recognized standing equivalent to that required for Fellows under paragraph (*a*) or (*b*).

(*e*). A person who holds in a principal national electrical engineering society of some other country membership of a grade for which the qualifications indicate a standing equivalent to that required for the grade of Fellow under paragraph (*a*) or (*b*).

3. Change Article III by deleting the words "professional engineers of standing" and by substituting the words "engineers of standing in the profession." The last paragraph of Section 10 will then read:

Should an applicant for admission or transfer certify that he is not personally known to the above specified number of Fellows, Members, or Associates who are sufficiently familiar with the applicant's experience to justify him in using their names as references, the Board of Examiners may accept, for the deficiency, other references, preferably engineers of standing in the profession.

War Reflected in Fall Symposium Papers

Two important symposiums, one on high-frequency cables, the other on central-station auxiliaries, will be features of the "fall technical paper program," scheduled in lieu of the Pacific Coast technical meeting. Both symposiums are the result of experiences gained from conferences held during the 1945 winter technical meeting, which indicated extensive interest in these subjects and collected information which is considered valuable enough to become a part of the permanent record in AIEE *Transactions*.

The symposium on high-frequency cables represents a gathering together of 17 technical papers and four summaries of discussions by authors who have taken a prominent part in the theory, development, and manufacture of high-frequency cables which were greatly accelerated by the war effort. The symposium is sponsored by the AIEE committee on communication and was arranged by Lieutenant Commander John H. Neher, chairman, Army–Navy Radio-Frequency Cable Co-ordinating Committee.

The symposium on central-station auxiliaries will present the point of view of several large electrical manufacturers and operating companies on power systems and electric drives for power-generating stations. This symposium is sponsored by the AIEE committee on power generation.

In addition to the symposiums other papers will be offered in the fields of air transportation, power transmission and distribution, protective devices, industrial power applications, and electric machinery. Abstracts of the papers will appear in subsequent issues of *Electrical Engineering*, and an announcement of the complete program will be mailed to all AIEE members in September.

Lamme Medalist Reviews A-C Design Work

In presenting the Lamme Medal to Soren H. Mortensen, doctor of engineering, at the AIEE annual meeting on June 27, 1945, R. S. Fleshiem, manager of the electrical department of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., said that "achievement," inscribed on the medal, carried a special significance for this year's winner. He then referred to the winner's work in the development of self-starting synchronous motors and for his contributions to the development of large hydraulic and steam-turbine-driven generators. Summing up, Mr. Fleshiem said that this year's winner of the Lamme Medal was outstanding in the field of self-starting synchronous motors, large salient-pole machines, ventilation of motors and generators, amortisseur windings, coil design, large air- or hydrogen-cooled turbogenerators, turborotor ventilating systems, hydrogen seal, and lead construction. Furthermore, his extensive contributions in the field of technical writing included his well-known work, "Electrical Machine Design," and the section, "Alternating Current Generators and Motors," in the 1941 edition of the McGraw-Hill "Standard Handbook for Electrical Engineers." Doctor Mortensen's personal service to AIEE was then extolled especially for his work on various committees and for his many illuminating articles and papers.

In accepting the Lamme Medal for 1944, Doctor Mortensen said he realized that the award was not a recognition of his personal efforts but rather of the accomplishments of the Allis-Chalmers Manufacturing Company and those of its engineers in the electrical field. Carrying his listeners back to the turn of the century he told of his joining the trek of European engineers who migrated to the United States to enlarge their horizons by contact with some of its brilliant engineers. He said that two big events in his life occurred when he joined the AIEE and when he was made assistant to R. B. Williamson who was in charge of a-c design at the Allis-Chalmers Manufacturing Company. Touching upon some of his experiences as a machine designer during four decades, he then paid tribute to the AIEE for its help and inspiration, and to his coworkers and colleagues, and especially, the men under whose guidance the electrical department of Allis-Chalmers Manufacturing Company grew. Specifically he mentioned among others R. S. Fleshiem "under whose cheerful guidance and direction the major part of my work in this field was accomplished and for his gracious words spoken in my behalf today, I extend humble and grateful appreciation."

Engineers Council Promoted by Houston Section

The AIEE Houston Section has been intrumental in effecting the formation of the Engineers Council of Houston, Texas. The Section is represented in the council by H. P. Heafer (M ’35) division plant engineer, Southwestern Bell Telephone Company, and a past chairman, and S. C. Commander M ’36) sales department, Joslyn Southwest Company and chairman.

The object of the council shall be:

1. To further the public welfare wherever technical and engineering knowledge and experience are involved.

2. To promote co-operation among the engineering ocieties.

3. To consider and act upon matters of mutual concern o the engineering and allied technical professions.

Ten societies or chapters of national societies are participating in the council. It represents more than 3,000 engineers, architects, chemists, and other technical specialists n the Houston area.

Arrowhead Subsection, Duluth, Established

Following several weeks of intensive work by two national members aided by other interested engineers the Minnesota Section, AIEE, has established the Arrowhead Subsection in Duluth, Minn. Because of time and transportation problems few of the engineers in the vicinity of the Great Lakes had been able to attend the regular Section meetings in Minneapolis or St. Paul. With the assurance that out-of-town speakers who were scheduled to speak at regular Section meetings in the Minneapolis–St. Paul area would also speak to a Subsection group in Duluth, it was possible to prove to the national members contacted that meetings would be assured if a sufficient number of interested engineers would attend.

An organization meeting was attended by 85 prospects who heard an out-of-town speaker. At the meeting Hubbell Carpenter (A ’41) engineer with the Minnesota Power and Light Company was elected chairman and R. H. Holmes (A ’45) affiliated with the same company, secretary-treasurer. Approximately 60 men signed applications for local members at this meeting. During the year the Subsection had seven meetings at which there was an average attendance of 94.

Technical Groups Formed in Southern District

The technical group committee of the East Tennessee Section has announced the formation of four technical groups in Knoxville and one technical group in Chattanooga. This Section is the first one in the Southern District to use the technical-group idea. The groups with their leaders are as follows:

Knoxville	Electronics	R. M. Alspaugh (M ’41)
Knoxville	Industrial power equipment	G. N. Hughes (M ’43)
Knoxville	Power generation	L. R. Sellers (M ’44)
Knoxville	Power transmission and distribution	H. H. Long (A ’30)
Chattanooga	Electronics	E. S. Staples, M. C. Charles (M ’41)

In the initiation of the program, both the Knoxville and the Chattanooga areas individually checked their memberships to ascertain what subjects were of interest and the extent of this interest. The results of this questionnaire were used as a basis for determining the organization of the discussion groups.

Fourteen meetings in all were held as of May 1 with four additional meetings during May. The average attendance at all meetings was approximately 11. The meetings brought forth considerable discussion which served not only to increase the knowledge and widen the viewpoint of the participants along the lines of the discussion, but also served as a medium to develop closer personal acquaintance among those interested in the same subjects. All the group leaders worked diligently to make the group discussions successful. Among them should be mentioned M. S. Merritt, chairman, and Messrs. E. B. Doocey, R. A. Hopkins, J. E. Housley, E. E. Jones, R. W. McEver, J. C. Tarboux, C. E. Tarwater, Mead Warren, Jr., and T. D. Talmage.

Work and Play Program at Seattle

“Fun with Science” was the subject of a talk given by C. N. Key of the Pacific Telephone and Telegraph Company before the May 22 meeting of the Seattle Section AIEE; Section officers for the 1945–46 period were elected, and a good time was enjoyed by all members and nonmembers who carried away an assortment of attendance prizes, as shown in the accompanying illustration.

Last year the Seattle Section began the issuance of lapel-pocket identification cards to those in attendance at the meetings—white cards for members of the Institute, and yellow cards for nonmembers. This gave an exact count of the attendance, and the nonmember cards were turned over to the membership committee for further investigation. The white cards for the entire season were carefully saved by the attendance chairman and were gathered together for the May 22 meeting. The winners had to be present to win. In this spirit of jollity and good fellowship the Seattle meetings were adjourned for the season.

Dayton Section Hears Talk on Audible Signaling

“Audible Signaling for the Armed Services” was the subject of an address given by Edward S. Ruth (M ’36) chief engineer of Edwards and Company, Inc., Norwalk, Conn., before a recent meeting of the Dayton Section of the AIEE.

Mr. Ruth explained in detail the work of a committee organized in May 1932 following a proposal of the Acoustical Society of America to the American Standards Association for standards of terminology units, scales, and methods of measurement in the field of acoustics. This committee established standards to define numerical scales and other essentials for measuring the loudness and intensity of sounds. A number of investigations was made and the results, Mr. Ruth said, could be taken as the best indications of the present material with, however, the necessary recognition that they may need modification when farther data are obtained.

Previous to the beginning of World War II manufacturers of audible signals had never thought of using the decibel or loudness unit in connection with their products. The specifications of the armed services did rate all audible signals in decibels and made a specific distance from the microphone a part of their specification. The Army Air Forces used three feet; the Navy 18 feet and 15 feet. Some Signal Corps specifications called for a definite sound-pressure output expressed in dynes per square centimeter.

Prize winners at Seattle Section AIEE meeting

Front row, left to right: K. L. Schubert, C. F. Myers, R. A. Walker, Alvia Lohoff (guest), J. W. Ferguson, C. C. Cornfield, J. A. Schrengohst, J. W. Allen, and T. B. Correy, Rear row, left to right: L. A. Traub, C. D. Howe, R. E. Kistler, A. H. Kassens, H. R. Brown (secretary-treasurer), C. H. Cutter (chairman), G. H. Walker, E. B. Hansen (vice-chairman) and Art Kramer

By and large, Mr. Ruth claimed, the services were ahead of the audible-signal industry.

Before the influx of large orders from the armed services the industry in general rated gongs by the diameter of the gong shell. Navy specifications would not generally accept the no-contact types—an improvement over the contact, clapper types in their long life and nonradio-interference characteristics—contending that the 60-beat action was entirely too fast for efficient sound output of the gong shell. Many bells for Navy use were for operation on 60-cycle alternating current, but in some instances only direct current was available for signaling. Therefore, a-c and d-c audible signals were required. The Signal Corps required d-c signals only. The Army Air Forces use 30-volt d-c generators for signaling and d-c signals are the rule in this branch of the service. In general, specifications of the armed services uniformly called for audible signals to withstand, without impairing their efficiency, the effects of vibration, salt spray, and moist humid atmospheres encountered in the tropics, and the effect of extremely low temperatures.

Mr. Ruth concluded his talk with some interesting data on the use of aluminum for the cases and covers until the aluminum shortage and the subsequent shortage of copper products called for the ingenuity of all in the use of steel as a solution.

High-Frequency Heating Developments Reviewed

Some of the accomplishments of industry at war through the electronic development of high-frequency heating and the possibilities for its applications in peacetime were related by Carl J. Madsen (M '44) electronics engineer of the Westinghouse Electric Corporation, East Pittsburgh, Pa., at a recent meeting of the Charleston, W. Va., Section of the AIEE. He said that proper industrial application of dielectric heating can increase production two to ten times that obtained by other methods, and that it also can decrease the number of rejects of a manufactured item, and result in an improved final product.

In the inductive field, applying high frequencies to objects that are conductors, great strides also have been made, the speaker said. Inductive applications are now widely used in the case-hardening of gear teeth and bearings, in brazing, soldering, and heat-treating. Heat-treating by induction often saves as much as 20 per cent of time and cost in manufacturing process, Mr. Madsen said, because it left no scale to be removed as do older methods of heat-treating. Electrolytically deposited tin is being "flowed" in a continuous process line at speeds of more than 1,000 feet per minute. This process produces mirror-smooth tin plate suitable for many purposes.

Mr. Madsen remarked further that electronic tubes create the waves that case-harden engine parts. The electrical current produced by these tubes and sent into an induction coil to be transferred into the engine part may change its direction of flow as often as 900,000 times a second. By varying this frequency and time, the depth of the hard-metal coating can be controlled to within a few hundredths of an inch.

Section Works for City Betterment. The public relations committee of the AIEE Houston Section has prepared and presented a completely rewritten electrical code for adoption as a part of the new city building code. This work was done at the request of the officials of Houston, Tex.

STANDARDS • • • •

Recommended Practice for Electrical Installations on Shipboard. The AIEE committee on marine transportation has prepared a revision of AIEE Standard 45, "Recommended Practice for Electrical Installations on Shipboard." This revision was approved by the Standards committee on June 25 and by the board of directors on June 27. The revision is now in the hands of an editing committee. When its work is completed, the publication of the revision will then get under way. The new edition, which will supersede the present issue of 1940, will not be available until the end of 1945.

Code for Protection Against Lightning. The National Bureau of Standards has issued a revision of the Code for Protection Against Lightning, Parts I, II, and III. This is known as Handbook *H*40 (superseding *H*21) and is available through the Superintendent of Documents, Washington, D. C., at a cost of 20 cents. This revision was prepared by a sectional committee working under the rules of procedure of the American Standards Association and the sponsorship of the Institute, the National Bureau of Standards, and the National Fire Protection Association. Parts I and II remain as in the previous edition; only part III has been revised.

Expulsion-Type Distribution Lightning Arresters. A subcommittee of the AIEE committee on protective devices has prepared a proposed standard on "Expulsion-Type Distribution Lightning Arresters." This was approved by the Standards committee on June 25 and by the board of directors on June 27 for publication by the Institute as a "Proposed Standard." Notice of availability will be given in these columns.

Sign of Reactive Power. A special subcommittee of the Standards committee, under the chairmanship of R. C. Bergvall, has been at work for more than a year studying the question of the sign for reactive power. This controversial subject was first considered by a special committee of the Standards committee in 1933. Following the acceptance of that committee's report by the AIEE Standards committee, recommending a negative sign (the vector for reactive power to be drawn downward), the convention became an American Standard and later was approved by the International Electrotechnical Commission. The convention of the negative sign was adopted by the commission in 1936. In 1944, the Institute's committee on power transmission and distribution asked for a reopening of the question, pointing out that the existing standard was actually in conflict with the generally accepted practice of the operators. The Standards committee therefore again referred the matter to a new subcommittee with instructions that a careful review of all phases of the problem be undertaken. A comprehensive canvass was made and the committee's report recommending a reversal of the present Standard from a negative sign to a positive sign was received by the Standards committee at the meeting on June 25, at which time (following a protest on the reversal of the present Standard by the AIEE instruments and measurements committee) the report was ordered referred to the American Standards Association for consideration.

Conduction in Stationary Contact Surfaces. A revised report of the subcommittee, W. P. Dobson, chairman, on conduction in stationary contact surfaces, of the Standards committee will shortly be available in mimeographed form. Those interested may obtain copies from Institute headquarters.

Turbine-Generator Standards and Specifications. A new pamphlet in the AIEE Standards series is now available covering "Preferred Standards for Large 3,600-Rpm Three-Phase 60-Cycle Condensing-Type Steam-Turbine Generators" and "Standard Specification Data for Generators," for such units, both in the class of machines larger than 10,000-kw capacity. A detailed account of these Standards for steam turbine generators was given in *Electrical Engineering*, May 1945, page 180. These publications are identified as 601 and 602 in the AIEE series and are published as one pamphlet at a cost of 30 cents, with the usual 50-per-cent discount to AIEE members on single copies.

Electric Welding Standards Withdrawn. The two former AIEE Standards 38 and 39, "Electric Arc Welding Apparatus" and "Resistance Welding Apparatus" (American Standards Association *C*52.1 and *C*52.2) respectively, approved and published in 1933 were withdrawn at the suggestion of the Institute by official action of the ASA on April 13, 1945. This action was necessary as the two Standards were considered obsolete. The work of preparing revised standards is going forward under the control of a sectional committee sponsored by the American Welding Society.

Test Code for Synchronous Machines. A revised edition of "AIEE Test Code for Synchronous Machines," originally issued in 1937 as a report on a proposed code, was approved by the Standards committee on June 25 and by the board of directors on June 27. The preparation of this revised code was carried out by a subcommittee of the committee on electric machinery, L. A. Kilgore, chairman. This code contains instructions for conducting the more generally applicable and accepted tests to determine the performance characteristics of synchronous machines. It is not intended that the code shall cover all possible tests, or tests of a research nature. It includes performance tests for synchronous generators and motors (larger than fractional horsepower) synchronous condensers, frequency changers, and rotary phase advancers. Copies may be obtained from AIEE headquarters, 33 West 39th Street, New York 18, N. Y., at a cost of 60 cents each, with the usual 50-per-cent discount to members on single copies.

Third Progress Report on AIEE Aeronautical Standards

Many members of the Institute are participating in the standardization work on aeronautical equipment, the scope of which was outlined previously in progress reports of October 1944 and February 1945 (*EE, Nov '44, p 412, March '45, p 122*). Cooperation is being given by other interested organizations. J. D. Miner, Jr. (M '42) engineering manager, small motor division, Westinghouse Electric Corporation, Lima, Ohio, has been appointed chairman of this committee, succeeding D. R. Shoults (M '42). The work being carried on by the four active subcommittees is summarized as follows:

AIRCRAFT ELECTRIC SYSTEMS SUBCOMMITTEE

Under the chairmanship of R. H. Kaufmann (M '41) a memorandum outlining the scope and subject material proposed for the informative type of report was prepared and widely distributed throughout the industry to competent engineers and aeronautical authorities, inviting contributions of pertinent data. Aeronautical Radio, Inc., is fully co-operating in this work along with the Society of Automotive Engineers, National Electrical Manufacturers Association, the Army Air Forces, and the Navy Bureau of Aeronautics. A. F. Trumbull (M '44) aeronautical engineer, recently was appointed a member of this subcommittee. Individual topic assignments have been given and it is expected that a first draft of the proposed report will be prepared shortly. Substantial progress has been made on the formulation of procedures for evaluating the volt-ampere characteristics of composite aircraft systems.

AIRCRAFT ELECTRIC ROTATING MACHINERY SUBCOMMITTEE

This group under the chairmanship of M. L. Schmidt (M '43) is engaged in preparing a test code for aircraft electric machinery, the scope of which will be "all rotating machinery which operates from/or is connected to a d-c system of an airplane." A first draft of this code has already been outlined and is now in the process of preparation.

AIRCRAFT ELECTRIC CONTROL AND PROTECTIVE DEVICES SUBCOMMITTEE

This group under the chairmanship of R. A. Millermaster (M '34) has as its responsibility the preparation of standards and test codes. It is collaborating with the Electrical Systems Subcommittee in developing a more adequate procedure for testing the interrupting capacity of aircraft circuit breakers.

AIRCRAFT WIRE AND CABLE SUBCOMMITTEE

This group under the chairmanship of W. S. Hay is preparing a test code for evaluating aircraft wire and cables and recommendations for the protection of aircraft wire and cable circuits, considering short-time and long-time thermal abilities and environmental conditions, and reviewing the present methods of rating aircraft wires and cables. Considerable progress has been made in standardizing methods of testing and evaluating aircraft cable thermal test data.

AIRCRAFT D-C APPARATUS VOLTAGE RATINGS

A report is now available as AIEE publication 700 and is being given wide distribution throughout the industry.

SAE AIRCRAFT ACCESSORIES AND EQUIPMENT

The Institute was represented at a meeting of Society Automotive Engineers committee *A*-2, aircraft electric equipment, at Dayton, Ohio, on May 29–30, with C. C. Shangraw, chairman, presiding. Discussion was held on *AN-M*-10 aircraft, d-c 24-volt motors, *A-N* aeronautical specification, thermal protection for electric motors, industry standardization of aircraft electric equipment, cooling-air requirements for generators, alternators and motors, spline lubrication, and standardization of ground to aircraft servicing equipment connections.

PERSONAL • • • • •

T. S. Oliver (A '30, M '43) underground engineer, Public Service Company of Colorado, Denver, **N. R. Love** (A '25, M '38) chief engineer, Denver Tramway Corporation, and **Hubert Sharp** (A '25, M '31) protection engineer, Mountain States Telephone and Telegraph Company, Denver, have been awarded the 1944 District 6 best paper prize for their paper, "The Effect of Large Rectifiers on Power-System Wave Shape and Telephone-Circuit Noise." Mr. Oliver was born in Chester, Pa., and was graduated from Swarthmore College in 1925. He was associated with the Westinghouse Electric and Manufacturing Company, on the test floor as regular tester, and with the Philadelphia Electric Company as technical assistant. Mr. Love was born in London, England, in 1892 and was graduated from the Colorado College with the degree of bachelor of science and as electrical engineer. From 1912–15 he worked as a special apprentice with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., specializing in works management. From 1915–17 he served as instructor in electrical engineering at Colorado College, Colorado Springs. In the latter year he became associated with the Denver Tramway Company and served as special study engineer, assistant chief engineer, and chief engineer. Mr. Sharp was born in Blackwater, Ariz., and was graduated with the degree of bachelor of science in electrical engineering from the University of California. He has been associated with the Mountain States Telephone and Telegraph Company since 1917, first doing drafting and surveying work, then equipment installation and circuit work, and later serving as electrical engineer's assistant, and protection engineer's assistant.

P. S. Clapp (A '18) vice-president of the Columbia Gas and Electric Corporation, Columbus, Ohio, who has recently been awarded the Marston Medal, was born at Toledo, Iowa. He was graduated from Iowa State College in 1913 as an honor student in electrical engineering. His engineering career started with a student-training course at the Western Electric Company in Chicago, Ill. Later he transferred to the New York laboratories where he assisted with the work being done on the then newly developed vacuum tube. In 1917 he became assistant purchasing agent for the Allied Machinery Company. With the entry of the United States into World War I, he became a captain in the Signal Corps and was in charge of engineering of communications for tanks and airplanes at the laboratories in Little Silver, N. J. In France in 1918 he established a factory for the final assembly of small dry-cell batteries for the American Expeditionary Forces. With the end of the war, he was assigned to the Allied Peace Commission, and also served on the Allied Relief Commission under Herbert Hoover. He then returned to the Western Electric Company, but was invited to travel to Russia in 1921 as a member of the Russian Food Relief Commission. In 1923 he was personal assistant to Herbert Hoover and three years later was made managing director of the National Electric Light Association. In 1932 he was named vice-president of the Columbia Gas and Electric Corporation and since that time has been associated with that organization and its subsidiaries.

H. T. Kohlhaas (M '19) editor of *Electrical Communication*, technical journal of the International Telephone and Telegraph Corporation, New York, N. Y., has been appointed an assistant vice-president. Mr. Kohlhaas received the bachelor-of-science degree in general science from Cooper Union in 1907, three years later he was awarded the degree of electrical engineer from the Brooklyn Polytechnic Institute, and in 1914 was awarded the same degree from Cooper Union. In 1905 he became associated with the Western Electric Company taking a special students' training course and acting as telephone and telegraph inspector. In 1908 he was engaged in engineering check inspection of telephone and telegraph apparatus. For the next six years he was engaged in designing telephone apparatus and subsequently was in charge of the apparatus analysis section in the physical laboratory. In 1922 he was appointed executive personnel assistant to the system's engineer of Bell Telephone Laboratories, Inc., and later Mr. Kohlhaas was transferred to the International Western Electric Company to make statistical studies and to serve as editor of *Electrical Communication.* Through the purchase of that company he became a member of the staff of the International Telephone and Telegraph Corporation. During 1937–39 he edited the journal from London serving also as publicity representative of the International Telephone and Telegraph Corporation and the International Standard Electric Corporation.

William Spraragen (A '17, M '26) executive secretary of the Welding Research Council, New York, N. Y., has been appointed to the newly created position of director. Mr. Spraragen was born in Warwick, N. Y., and was graduated from Union College with a bachelor-of-engineering degree in 1916. His career includes service with the General Electric Company in charge of the test department, with the testing department of the Westinghouse Electric Corporation; and as instructor of electrical engineering at the University of Washington, Seattle. Mr. Spraragen has long been identified with research and welding. He has served as executive secretary of the Welding Research Council since its organization in 1935 and his connection with the welding industry dates back to 1918 when he was appointed research assistant to the Welding Research Committee of the National Council of Defense and the Emergency Fleet Corporation. From 1920–34 Mr. Spraragen was secretary of the division of engineering, National Research Council and secretary of the American Bureau of Welding from 1921–36. He served as technical secretary of the American Welding Society from 1927–42. He is editor and business manager of *The Welding Journal*, official publication of the society of which he has been editor since publication was started in 1922. He is author or coauthor of many critical reviews of the literature on practically every phase of welding. He was a member of the AIEE electric welding committee for several years.

C. R. Burrows (A '26, M '33) of the radio research engineering department of the Bell Telephone Laboratories, Inc., New York, N. Y., has been appointed professor of electrical engineering and director of the school of electrical engineering at Cornell University, Ithaca, N. Y. He will assume his new duties in September. Doctor Burrows was born in Detroit, Mich., and received the degrees of bachelor of science in engineering, and electrical engineering from the University of Michigan and the degrees of master of arts and doctor of philosophy from Columbia University. He began his engineering career with the Western Electric Company, New York, N. Y., which became identified with Bell Telephone Laboratories, Inc., in 1925. For three years he was engaged in transatlantic and South American transmission experiments on the development of short-wave radiotelephone channels. He spent one year on experimental and theoretical study of phase modulation and the distortion it introduces in the received signal; two years on tuned antennas; seven years as supervisor of a group of engineers making an experimental investigation of the propagation characteristics of ultrashort waves; one year on the exponential transmission line; and since 1938 he has been engaged in research on ultrashort-wave transmitters. Doctor Burrows is the author of a number of papers dealing with these investigations.

B. V. Hoard (M '36) chief, a-c calculating board studies unit, Bonneville Power Administration, Portland, Oreg., and **G. W. Bills** (A '38) United States Naval Reserve, have been awarded the 1944 District 9 best paper prize for their paper, "An Analysis to Determine the Optimum Bussing Arrangements and Transmission Capabilities at Grand Coulee." Mr. Hoard was born in Elk City, Okla., and was graduated from the University of Washington in 1924 with the degree of bachelor of science in electrical engineering. From 1925–26 he was an engineering student with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and from the latter year to 1931 he served as electrical engineer in the general engineering department. For the next two years Mr. Hoard taught electrical engineering at the University of Pittsburgh, Pa. In 1933 he went with the Consolidated Edison Company of New York, Inc., New York, and was employed as junior engineer and later engineering assistant. Mr. Bills was born in Tacoma, Wash., and was graduated in June 1938 as electrical engineer from the University of Washington. He became a teaching fellow at the University of Washing, Seattle, and in 1939 was made junior electrical engineer, Bonneville Dam project, Portland, Oreg.

R. D. McManigal (A '18) manager, associated companies department, Westinghouse Electric International Company, New York, N. Y., has been elected a vice-president of that company. After his graduation with the degree of electrical engineering from Lafayette College, Mr. McManigal joined the Westinghouse Company in 1915. He completed the company's student course, and for seven years, except for a period of service in the United States Navy during World War I, he was in the general engineering division at East Pittsburgh, Pa. In 1922 he went to Japan as an engineer for the Westinghouse Electric International Company and later served as managing director of the Westinghouse Electric Company of Japan. In 1931 upon the dissolution of that company he returned to New York and has served in the capacity of manager of the central station-transportation apparatus department, assistant to the vice-president, and manager of the associated companies department, his most recent post.

E. A. Walker (A '34, M '41) who has been in charge of the Ordnance Research Division at Harvard University, Cambridge, Mass., will be the director of the Ordnance Research Laboratory, dealing with underwater ordnance, at the Pennsylvania State College, State College, Pa., and the head of the electrical engineering department of the college. Doctor Walker was born in Long Eaton, England, and is a graduate of the Harvard Engineering School having received the degrees of bachelor of science in 1932 and master of science in 1933. He has been assistant professor of electrical engineering at Tufts College, Tufts College, Mass., and also head of the electrical engineering department at the University of Connecticut, Storrs. He has been associated with the Doble Engineering Company and the Colt Patent Fire Arms Company as a consultant. His research projects include work on the behavior of dielectrics at high voltages, the effect of moisture and aging on insulating oils, and the development of weapons for the Bureau of Ordnance.

William Fondiller (M '15, F '26) assistant vice-president of the Bell Telephone Laboratories, Inc., New York, N.Y., was awarded the university medal by Columbia University at the commencement exercises on June 5, 1945. Mr. Fondiller was born in Minsk, Russia, and was graduated from the College of the City of New York with the degree of bachelor of science in 1903, from Columbia University with the degree of electrical engineer in 1909, and received his master-of-arts degree from the same university in 1913. He began his practice of electrical engineering in the physical laboratory division, engineering department of the Western Electric Company, New York, N. Y. By 1920 he was in charge of a group of 75 engineers engaged in the commercial development of all wound apparatus used in the Bell system. In 1923 he became head of the general development laboratory comprising a staff of 190 people. Mr. Fondiller served as a member of the AIEE electrophysics committee from 1922–24 and is the author of numerous papers.

Dimiter Ramadanoff (M '37) research electrical engineer and physicist of the National Carbon Company, New York, N. Y., has been awarded the 1944 best paper prize for his paper, "High-Altitude Brush Problem." Mr. Ramadanoff was born in Sofia, Bulgaria, and received the bachelor-of-science degree in electrical engineering from the University of Illinois in 1924, and the doctor-of-philosophy degree from Cornell University in 1932. In the summers of 1920–1923 he worked with the American Steel Foundries in Granite City, Ill., and as electrician with the Chicago and Northwestern Railway in Chicago, Ill. Successively thereafter he was research physicist at the University of Illinois, installation engineer, Ward Electric Company, Miami Beach, Fla., electrical engineer, Michigan Bell Telephone Company of Detroit; instructor in electrical engineering at Cornell University, Ithaca, and research engineer with the research laboratory of the General Electric Company.

C. K. Duff (A '28, M '41) meter engineer, operating department, Hydro-Electric Power Commission of Ontario, Toronto, Canada, was awarded the 1944 District 10 best paper prize for his paper, "Load, Frequency, and Time Control of Interconnected Systems." Mr. Duff was born in Hamilton, Ontario, Canada, and was graduated from the University of Toronto with the degree of bachelor of applied science in electrical engineering in 1918. From 1918–21 he was research assistant, school of engineering research, faculty of applied science University of Toronto. From 1921–27 he was a teacher of science in Wesley College, Wuchang, Hupeh, China, and in the last-mentioned year he again was research assistant, school of engineering research, University of Toronto, doing researches on automatic speed and frequency control. In 1934 he took the position of meter engineer with the Hydro-Electric Power Commission.

C. C. Crane (A '25, M '31) chief engineer of the Wisconsin Electric Cooperative, Madison, has resigned to enter the consulting engineering field in Madison. Mr. Crane was born in Hillsdale, Mich., and was graduated from the University of Michigan in 1923 with the degree of bachelor of science in electrical engineering. He has spent most of his time in the design and construction fields with various public utilities, among them the Utah Power and Light Company, Salt Lake City, and the Commonwealth Power Corporation, Jackson, Mich. In 1938 he joined the staff of the Federal Power Commission, Washington, D. C., and in 1942 was assigned to the inventory control branch of the Office of War Utilities. In October 1943 he returned to the power section of the Federal Power Commission.

J. T. Madill (A '41) system protection engineer, Aluminum Power Company, Ltd., Shipshaw, Quebec, Canada, was awarded the 1944 District 10 initial paper prize for his paper, "Field Decay Characteristics of Large Hydroelectric Generators." Mr. Madill was born in Edmonton, Alberta, Canada, and was graduated from the University of Alberta with the degree of bachelor of science in electrical engineering in 1939, and received a master-of-science degree in 1940 from Massachusetts Institute of Technology. Before his affiliation with the Aluminum Power Company he was employed in the design and appraisal division of the Ebasco Services, Inc., New York, N. Y., where he assisted in preparing systems for study on the a-c network analyzer.

C. G. Mansfield (A '25, M '42) assistant underground design engineer, design and construction division, water and power department, City of Los Angeles, Calif., has been awarded the 1944 District 8 initial paper prize for his paper, "New 138-Kv Cable Lines in Los Angeles." Mr. Mansfield was born in Danbury, Conn., and received the bachelor-of-science degree in electrical engineering in 1923 from the University of Wisconsin. He joined the General Electric Company, Schenectady, N. Y., as student in the test course, later becoming engineer at the Pittsfield, Mass., office. In 1926 he became affiliated with the Los Angeles Bureau of Power and Light and has conducted numerous investigations and studies relating to that system.

Alfred Glasgow (A '08) formerly assistant superintendent of transmission and distribution, San Diego (Calif.) Gas and Electric Company, has been made department superintendent. Mr. Glasgow, a 1901 graduate of Pennsylvania State College, entered the employ of the San Diego company in 1916 as manager of its Oceanside district. He previously had been associated with the General Electric Company, Schenectady, N. Y.

E. E. Scofield (A '43) of the consulting and research department, Washington Water Power Company, Spokane, has been made manager of wholesale and special contracts. Mr. Scofield, who has been with the company since 1922, has been draftsman, assistant industrial engineer, manager of industrial sales, assistant manager of the rate department, and supervisor of power contracts and statistics.

S. G. Hibben (A '34) director of applied lighting and **C. M. Slack** (M '43) assistant director of research, lamp division, Westinghouse Electric and Manufacturing Company, Bloomfield, N. J., have been awarded the Westinghouse order of merit. Mr. Hibben was honored for his development work on light. Doctor Slack was cited for creating high-speed X-ray tubes and developing their wartime applications.

W. D. Kleppinger, Sr. (A '39) formerly assistant engineer with Consolidated Edison Company of New York (N. Y.), Inc., and later general superintendent for Ford, Bacon and Davis, Inc., New York, has accepted a commission as lieutenant (junior-grade), United States Naval Reserve, and has been assigned temporarily to the industrial department of the Philadelphia (Pa.) Navy Yard.

R. B. Hubbard (A '20, M '28) director of the industrial development department, Public Service Company of Colorado, Denver, and newly elected president of the Colorado Engineering Society, has been made manager of the Rocky Mountain Electrical League. Mr. Hubbard has been granted a two-year leave of absence by the Public Service Company.

C. H. Spiehler (M '28) mechanical engineer, Cincinnati (Ohio) Gas and Electric Company, has accepted the position of mechanical consulting engineer for the Dayton (Ohio) Power and Light Company. Mr. Spiehler rejoins the company, after having been with them from 1910 until 1926 in the design and operation of the district heating and power stations.

E. W. Baker (A '40, M '44) formerly head of the toll transmission group, American Telephone and Telegraph Company, New York, N. Y., has been appointed head of a recently organized group on toll-line dialing and new special services. Mr. Baker, a 1924 graduate of Lehigh University, has been employed by the Bell System since his graduation.

H. I. Romnes (A '41) operation engineer, engineering department, American Telephone and Telegraph Company, New York, N. Y., has been appointed head of the company's toll transmission group. Mr. Romnes, who formerly was employed by Bell Telephone Laboratories, Inc., New York, has been in the transmission section since 1935.

H. R. Lee (A '38, M'44) of the electric transmission-line department, United States Bureau of Reclamation, Denver, Colo., has been named power manager. Mr. Lee is a former chief of the power marketing and sales division of the bureau and for a time was Denver regional utility engineer for the War Production Board.

A. W. Milliken (A '30) vice-president, New York State Electric and Gas Corporation, Brewster, has been made superintendent of operations. Mr. Milliken, who has been a vice-president and manager of the company's eastern division since 1939, was associated with the New Bedford (Mass.) Gas and Edison Light Company from 1922 to 1939.

N. L. Rea (A '02) superintendent of electrical installations, contract service department, General Electric Company, Schenectady, N. Y., has been made engineering consultant in the service engineering division of the company. **W. C. Plumer** (A '24, M '30) engineer, General Electric Company, Buffalo, N. Y., succeeds Mr. Rea.

C. W. McGill (A '35, M'44) formerly head of the transmission and station planning division, Boston (Mass.) Edison Company, has become head of the company's electrical section. **E. A. Church** (A '29, M'45) of the company's engineering department succeeds Mr. McGill.

J. J. Smith (A '19) assistant engineer, general engineering laboratory, General Electric Company, Schenectady, N. Y., has been appointed chairman of the American Standards Association war committee on methods of measuring radio noise.

L. S. Curs (A '38) lieutenant colonel, Signal Corps, United States Army, has been awarded the Bronze Star medal. He was cited for his services in the installation of radio, telephone, and teletype facilities in the Persian Gulf Command.

Harold Goldberg (A '35, M'44) formerly senior engineer with the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has been appointed a research engineer of the radio division, Bendix Aviation Corporation, Baltimore, Md.

P. L. Bellaschi (A '29, F '40) development engineer, Westinghouse Electric and Manufacturing Company, Sharon, Pa., has returned from a four-months' tour of South America for the Westinghouse International Company.

S. B. Storer (A '39) managing engineer, Norwood (Ohio) division, Trumbull Electric Manufacturing Company, has been appointed to the panelboard and distribution-board section of the National Electrical Manufacturers Association.

S. V. Hart (A '43) now application and development engineer, Radio Corporation of America, Indianapolis, Ind., was incorrectly referred to as **S. B. Hart** in the notice of his appointment which appeared in the March 1945 issue of *Electrical Engineering*.

E. P. Fetherstonhaugh (A '09) professor of electrical engineering and dean of the faculty of engineering and architecture, University of Manitoba, Winnipeg, Canada, has been elected president of the Engineering Institute of Canada.

H. L. Etheridge (M '44) formerly chief of engineering section, Newfoundland Base Command, United States Army, is now in the engineering division, Raytheon Manufacturing Company, Waltham, Mass.

J. L. Woodress (A '07, M '21) assistant secretary and director of sales, Century Electric Company, St. Louis, Mo., has been elected president of the St. Louis Electrical Board of Trade.

J. F. Peters (M '14 F '23) consulting engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been awarded the order of merit, highest honor bestowed on an employee.

E. P. Bancroft (M '42) general department, International Standard Electric Company, New York, N. Y., is in Rio de Janeiro, Brazil, in order to study the communications situation in that country.

F. R. Lack (M '37) vice-president and manager, radio division, Western Electric Company, Inc., New York, N. Y., has been elected to the board of directors of the American Standards Association.

P. G. Weiller (A '43) formerly in charge of the research department, Square D Company, Woodside, N. Y., has established offices and a research laboratory in New York, N. Y.

O. W. Titus (A '29, F '44) chief engineer of the Canada Wire and Cable Company, Ltd., Toronto, Ontario, Canada, has been elected president of the Toronto Electric Club.

M. J. Kelly (M '26, F '31) executive vice-president of the Bell Telephone Laboratories, Inc., New York, N. Y., has been elected a member of the National Academy of Science.

OBITUARY • • • • •

C. W. Caldwell (A '32) associate professor of electrical engineering, Purdue University, Lafayette, Ind., died on June 5, 1945. He was born in Warren, Ind., and received the degree of bachelor of science in electrical engineering in 1931, and the master-of-science degree in engineering in 1938 both from Purdue University. After teaching school in the rural districts of Huntington County and serving as electrician in Marion, Ind., he became assistant instructor in the drawing department of Purdue University serving in that capacity from 1927–29. Subsequently, he was research assistant in the electrical-engineering experimental station of that university from 1929–31. In 1931 he became acting head of the school of electrical engineering, University of South Dakota, Vermillion, and two years later was made head of the physics department where he remained until 1934. In the last-mentioned year he became instructor in electrical engineering at Purdue University, later becoming assistant professor and in charge of the electronics course.

C. F. Hanson ((A '18, M '37) chief consulting engineer, sales department, Irvington Varnish and Insulator Company, Irvington, N. J., died on April 27, 1945. Mr. Hanson was born in Arkansas City, Kan., and received the bachelor-of-science degree in electrical engineering and the degree of master of science from the University of Kansas in 1912 and 1913 respectively. From 1913–18 he served as assistant physicist with the Bureau of Standards, Washington, D. C., and from 1918–27 he was research director of the Habirshaw Cable and Wire Corporation, Yonkers, N. Y. For the next three years he was engaged in oil research for the R. T. Vanderbilt Company, East Norwalk, Conn. In 1930 he became affiliated with the Irvington Varnish and Insulator Company as technical director. He served on the AIEE instruments and measurements committee 1926–27. He was the author of "Required Power Factor Accuracy of Paper Cables."

H. R. Palmer (A '08, M '21) head electrical engineer, bureau of engineering, electrical section, Pennsylvania Public Utilities Commission, Harrisburg, died recently. Mr. Palmer was born in Murray, Orleans County, N. Y., in 1868. Early in his career he was identified with the Morristown Light, Heat and Power Company, Morristown, N. J., the Virginia Railway and Power Company operating electric light and power, and street railway in Richmond, Petersburg, Suffolk, and Norfolk, and later served as vice-president and general manager of the Harrisburg Light and Power Company, Harrisburg, Pa. For the last-mentioned he had direct general supervision of construction and operation of electric and steam heat systems, including steam and generating stations.

J. H. Bonine (A '17) partner in the Bra Bon Electric Company, Philadelphia, Pa., died May 12, 1945. He was born in Lancaster, Pa. In 1914 he became affiliated as construction engineer with the firm of Lewis and Roth Company which designed and built substations for plants making new materials, such as the Baldwin Locomotive Works, and Standard Steel Works. Later he became superintendent of the switchboard department of Lewis and Roth. Following the war's end he became secretary of the Electric Power Equipment Corporation of Philadelphia, successor to Lewis and Roth. In 1930 with C. S. Brangan he formed the Bra Bon Electric Company as manufacturers' agents.

C. R. Horrell (A '16, M '25), vice-president and general sales manager of the Sangamo Electric Company, Springfield, Ill., died on July 5, 1945. He was born in Stockville, Neb., on December 15, 1889, and was graduated from the University of Illinois with a bachelor-of-science degree in electrical engineering in 1913. He was first associated with the engineering sales department of the Electric Appliance Company, Chicago, Ill., where his work consisted chiefly of designing and laying out distribution and necessary connecting transmission lines. In 1919 he became sales manager of the Sangamo Electric Company and was appointed vice-president in 1941.

E. P. Karr (A '40) field engineer, Public Service Commission of Kentucky, Lexington, and a major in the United States Army was killed in action in Belgium on January 6, 1945. Major Karr was born in Lexington, Ky., in 1917, and received his bachelor-of-science degree in electrical engineering from the University of Kentucky in 1938 and the master-of-science degree from the same university the following year. He entered the service in June 1941 and had been overseas with the Signal Corps since October 1943.

A. J. Clarkson (M '26, F '34) superintendent of electric equipment, New York Central System, New York, N. Y., died on June 4, 1945. Mr. Clarkson was born on August 4, 1893, at Bloomington, Ill., and was graduated from the engineering department of the University of Illinois with the degree of bachelor of science. In 1916 he became associated with the New York Central System as draftsman and served in turn as checker, senior draftsman, inspector, and general inspector.

Adolph Hertz (A '18) statistician with the New York Edison Company, New York, N. Y., when he retired in 1933, died on May 31, 1945. Though born in Germany in 1867, and educated in England, Mr. Hertz became a citizen of the United States. He designed many of the electric rates used by the Edison company and by other utilities in the United States.

MEMBERSHIP • • •

Recommended for Transfer

The board of examiners, at its meeting of July 19, 1945, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the secretary of the Institute.

To Grade of Fellow

Gray, T. S., associate professor, Mass. Inst. of Tech., Cambridge, Mass.
Grigsby, L. C., elec. engr., Public Service Co. of Okla., Tulsa, Okla.
Groves, W. M., Jr., plant extension engr., Southwestern Bell Tel. Co., Dallas, Tex.
Laffoon, C. M., mgr., A. C. Engg. Dept., Westinghouse, Elec. Corp., E. Pittsburgh, Pa.
McFarland, T. C., chairman, div. of elec. engg., Univ. of California, Berkeley, Calif.
Miller, L. E., engr. in chge. of quality, Reliance Elec. & Engg. Co., Cleveland, Ohio.
Nott, G. E., chief engr., Pacific Tel. & Tel. Co., Seattle, Wash.
Robertson, L. M., trans. & station engr., Public Service Co. of Colorado, Denver, Colo.
Shute, E. R., vice-pres., Western Union Tel. Co., New York, N. Y.
Todd, J. M., cons. engr., Maritime Bldg., New Orleans, La.
Westbye, J. B., elec. engr., Gibbs & Hill, Inc., New York, N. Y.
Whitehead, E. R., investigating engr., Duquesne Light Co., Pittsburgh, Pa.

12 to grade of Fellow

To Grade of Member

Abfalter, E. J., asst. sec. engr., Fisher Body Div., General Motors Corp., Detroit, Mich.
Angel, H. H., asst. to elec. supt., Bethlehem Steel Co., Sparrows Point, Md.
Baccus, I. B., U. S. Navy, instructor in elec. engg., U. S. Naval Academy, Annapolis, Md.
Bodine, R. B., engr., General Elec. Co., Schenectady, N. Y.
Buchanan, D. V., asst. engr., Cons. Edison Co. of N. Y., Inc., New York, N. Y.

Christensen, P. L., chief, fuse & special device sec., Office, Chief of Ordnance, Washington, D. C.
Ellsworth, B. E. S., elec. engr., Nebraska Public Power System, N. Platte, Neb.
Fager, C. R., elec. engr., Mare Island Navy Yard, Mare Island, Calif.
Fagerlund, A. C., elec. engr., Air Technical Service Command, Wright Field, Dayton, Ohio.
Flora, W. W., private practicing & cons. engr., Flora Engineering Co., Cheyenne, Wyo.
Friedman, A., vice-pres. in chge. of engg., Columbia Elec. Mfg. Co., Cleveland, Ohio.
Garr, D. E., engg., General Elec. Co., Schenectady, N. Y.
Gise, L., district engr., Westinghouse Elec. Corp., Philadelphia, Pa.
Gorman, W. J., Jr., elec. engr., General Elec. Co., Schenectady, N. Y.
Gottron, G. L., member of technical staff, Bell Tel. Labs., Inc., New York, N. Y.
Grigsby, J. M., elec. engr., Modesto Irrigation District, Modesto, Calif.
Hammond, J. W., Comdr., USNR, Philadelphia Navy Yard, Philadelphia, Pa.
Harness, G. C., dist. engr., Westinghouse Elec. Corp., Philadelphia, Pa.
Heidelberger, O., elec. design engr., Master Elec. Co., Dayton, Ohio.
Hokanson, H. T., application engr., General Elec. Co., Schenectady, N. Y.
Hyde, M. A., Jr., elec. engr., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Johnson, R. F., design engr., General Elec. Co., Fort Wayne, Ind.
Jones, O. N., president, Ambos-Jones Co., Cleveland, Ohio.
Kres, A. J., engr., Ohio Bell Tel. Co., Cleveland, Ohio.
Kron, G., cons. engr., General Elec. Co., Schenectady, N. Y.
Larrick, C. V., Jr., elec. engr., General Elec. Co., Schenectady, N. Y.
Lee, C. F., engr., General Elec. Co., Cincinnati, Ohio.
Lord, H. W., engr., General Elec. Co., Schenectady, N. Y.
Manring, R. C., project engr., Combined Research Group, Naval Research Lab., Washington, D. C.
Martin, C. A., chief engr., Dingle-Clark Co., Cleveland, Ohio.
Mendelsohn, L. I., development engr., General Elec. Co., Lynn, Mass.
Menes, F. A., Jr., chief engr., Line Equip. Sect., Signal Corps Ground Signal Agency, Red Bank, N. J.
Miller, C. E., industrial engg. div., General Elec. Co., Schenectady, N. Y.
Miller, F. L., requisition engg., General Elec. Co., Schenectady, N. Y.
Morris, J. A., meter engr., American Gas & Elec. Serv. Corp., New York, N. Y.
Morris, J. A., meter engr., American Gas & Elec. Serv. Corp., New York, N. Y.
Muir, W., ind. control engg. div., General Elec. Co., Schenectady, N. Y.
Nelson, E. P., consultant, 29 Crest St., New London, Conn.
Oewel, J. A. G., engr., Pennsylvania Power & Light Co., Allentown, Pa.
Palka, G. A., elec. engr., Standard Transformer Co., Warren, Ohio.
Pedersen, A. M., supt. of elec. maint., Hydro-Elec. Pr. Comm. of Ont., Niagara Falls, Ont., Can.
Peterson, E. F., design engr., General Elec. Co., Schenectady, N. Y.
Pingon, A. C., resident representative, Compagnie Française Thomson-Houston, C/o Int. General Elec. Co., Schenectady, N. Y.
Pinkerton, D. C., radio transmitter engr., General Elec. Co., Schenectady, N. Y.
Purnell, L. J., assoc. prof. of elec. engg., head of dept. of elec. engg., Howard University, Washington, D. C.
Putnam, T. R., Colonel, Signal Corps, U. S. Army, 25 Ridgecrest West, Scarsdale, N. Y.
Rankin, A. W., engr., General Elec. Co., Schenectady, N. Y.
Ray, A. W., mgr., service dept., Reliance Elec. & Engg. Co., Cleveland, Ohio.
Rice, J. B., elec. tech. supervisor, Tennessee Eastman Corp.-Clinton Engineer Works, Oak Ridge, Tenn.
Rich, E. A. E., elec. engr., General Elec. Co., Schenectady, N. Y.
Robinson, R. C., elec. design engr., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Rohats, N., laboratory sect. head, General Elec. Co., Schenectady, N. Y.
Rossrucker, E. A., fundamental plan engr., Ohio Bell Tel. Co., Cleveland, Ohio.
Schaevitz, H., sr. electronic engr., Baldwin Locomotive Works, Philadelphia, Pa.
Scheldorf, M. W., radio engr., General Elec. Co., Schenectady, N. Y.
Sherer, H. P., chief engr., Hertner Elec. Co., Cleveland, Ohio.
Shott, H. S., cent. sta. engg. div., General Elec. Co., Schenectady, N. Y.
Sirrine, J. E., head, J. E. Sirrine & Co., Greenville, S. C.
Tesar, J. J., asst. elec. engr., Cleveland Elec. Illuminating Co., Cleveland, Ohio.
Thomas, J. W., watch engr., Potomac Elec. Pr. Co., Washington, D. C.
Thompson, J. D., engr., General Elec. Co., Schenectady, N. Y.
Unger, J. J., elec. design engr., Elec. Products Co., Cleveland, Ohio.
Walton, A. W., protective engr., Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Walworth, S. L., district mgr., Ohio Brass Co., Pittsburgh, Pa.
Whitmer, E. W., member, engg. dept., American Gas & Elec. Service Corp., New York, N. Y.
Winstandley, M. S., elec. constr. engr., Louisville Gas & Elec. Co., Louisville, Ky.
Woods, G. B., general foreman, testing div., General Elec. Co., Schenectady, N. Y.
Young, C. M., elec. engr., General Elec. Co., Schenectady, N. Y.
Zigler, M. O., proposition engr., General Elec. Co., Schenectady, N. Y.

69 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the secretary before September 15, 1945 or November 15, 1945, if the applicant resides outside of the United States or Canada.

To Grade of Member

Andrew, J. C. P., Callender's Cable & Const. Co., Ltd., Bandra, Bombay, India
Burns, D. (Re-election), Detroit Edison Co., Detroit, Mich.
Chester, C. E., Univ. College, Southampton, England
Dempsey, P. D., George H. Wahn Co., Boston, Mass.
Fickel, L. V. (Re-election), Tenn. Gas & Trans. Co., Houston, Texas
Garwood, G. T., West Hamp. Elec. Co., Ltd., Lyndhurst, England
Heymann, H., Midland Elec. Mfg. Co., Ltd., Birmingham, England
Hoffman, J. D., Gen. Elec. Co., Philadelphia, Pa.
Hoyt, J. C., Gen. Elec. Co., Philadelphia, Pa.
Izenour, G. C., Airborne Inst. Lab., Mineola, N. Y.
Joseph, B. R., Ministry of Works, London, England
Lees, H. S. (Re-election), Top O'Michigan Rural Elec. Co., Boyne City, Mich.
Linhoff, C. H. (Re-election), Gen. Elec. Co., Chicago, Ill.
McConaghy, C. M., J. B. Converse & Co., Inc., Mobile, Ala.
McJannet, D. W., Hackbridge Elec. Const. Co., Ltd., Surrey, England
Mellor, C. H., Cates & Shepard, Philadelphia, Pa.
Miller, A. L. (Re-election), Cleveland Elec. Illum. Co., Cleveland, Ohio
Moses, W. G., Rochester Ropes, Inc., Culpeper, Va.
Prentice, A. N., Ohio Power Co., Canton, Ohio
Rushing, F. C., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Saviers, G. B., Westinghouse Elec. Corp., Baltimore, Md.
Sherman, R., Copperweld Steel Co., Warren Ohio
Skillington, G. E., British Oil & Cake Mills, Ltd., Hull, England
Taylor, C. R., Enfield Cables, Ltd., London, England
Van Horn, W. K., Aircraft-Marine Products, Inc., Harrisburg, Pa.
Whitmore, C. W., Whitmore Elec. Co., Miami, Fla.
Wilbur, H. R., Metropolitan Edison Co., Reading, Pa.
Woodson, R. D., Black & Veatch, Kansas City, Mo.
Yost, J. J., Berylium Corp. of Pa., Reading, Pa.
Zimmerman, L. M., U. S. Naval Drydocks, San Pedro, Calif.

30 to grade of Member

To Grade of Associate

United States and Canada

1. North Eastern

Charlton, E. E., Gen. Elec. Co., Schenectady, N. Y.
Harding, C. R., U. S. Navy Yard, Portsmouth, N. H.
Hume, J. E. N., Gen. Elec. Co., Schenectady, N. Y.
Mouton, R. B., U. S. Navy Yard, Portsmouth, N. H.
Stocker, J. E., Gen. Elec. Co., Schenectady, N. Y.

2. Middle Eastern

Andrews, W. T., David Taylor Model Basin, Carterock, Md.
Arthur, J. M., Duquesne Light Co., Pittsburgh, Pa.
Bunjevac, M. M., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Carter, C. D., Westinghouse Elec. Corp., Sharon, Pa.
Castagna, F. C., U. S. Navy Dept., Washington, D. C.
Charny, D. P., 1522 Nedro Ave., Philadelphia, Pa.
Charlton, R. D., Gen. Elec. Co., Erie, Pa.
Day, E. H., Phila. Elec. Co., Philadelphia, Pa.
Deal, R. C. (Re-election), Gilbert Assoc., Inc., Reading, Pa.
DeCowsky, G. N., Phila. Elec. Co., Philadelphia, Pa.
Ewalt, L., Westinghouse Elec. Corp., Sharon, Pa.
Fitzsimmons, D. P. (Re-election), Union Switch & Sig. Co., Swissvale, Pa.
Flachbarth, C. T., Gen. Elec. Co., Philadelphia, Pa.
Georges, G. T., Gen. Elec. Co., Philadelphia, Pa.
Hess, W. F., Phila. Elec. Co., Philadelphia, Pa.
Kilheffer, L. D., National Cash Reg. Co., Dayton, Ohio
Knowlson, J. M., British Admir. Delegation, Washington, D. C.
Kurch, P. G., Penna. Transf. Co., Pittsburgh, Pa.
Lawrence, B. F. (Re-election), Westinghouse Elec. Corp., Bluefield, W. Va.
Lotz, C. A., Metropolitan Edison Co., Reading, Pa.
McGown, J. H., Phila. Elec. Co., Norristown, Pa.
Pomeroy, G. S., III, Metropolitan Edison Co., Reading, Pa.
Powell, R. M., Ensign, U.S.N.R., Washington, D. C.
Rose, A. S., Phila. Elec. Co., Philadelphia, Pa.
Roussey, W. I., Phila. Elec. Co., Philadelphia, Pa.
Shaw, N. C., Union Switch & Sig. Co., Swissvale, Pa.
Tabor, B., Ohio Elec. Mfg. Co., Cleveland, Ohio
Weiss, E. A., Naval Ord. Lab., Washington, D. C.
Willert, W. W., Air Way Elec. Appl. Corp., Toledo, Ohio
Zeitler, N. R., Westinghouse Elec. Corp., Sharon, Pa.

3. New York City

Bush, C. A., Weston Elec. Inst. Corp., Newark, N. J.
Chirles, R. J., Wright Aero Corp., Woodridge, N. J.
Gellrich, J. T., Fed. Tel. & Radio Corp., East Newark, N. J.
Li Calsi, J., Amer. Dist. Tel. Co., New York, N. Y.
Munson, A. J., Kellex Corp., New York, N. Y.
Willyoung, D. M., Curtis-Wright Corp., Bloomfield, N. J.

4. Southern

Bledsoe, T. A., Aluminum Ore Co., Bauxite, Ark.
Curran, R. W., Ark.-La. Gas Co., Little Rock, Ark.
MacKenzie, R. C., Watson-Flagg Engr. Co., Oak Ridge, Tenn.
Sheehan, T. R., Norfolk Shipbldg. & Drydock Corp., Norfolk, Va.
Stanhope, G. P., N.A.C.A., Langley Field, Va.
Sturman, B. J., Jr., Westinghouse Elec. Corp., Atlanta, Ga.
Winton, M. L., Tenn. Eastman Corp., Oak Ridge, Tenn.

5. Great Lakes

Anderson, A. R., Sargent & Lundy, Chicago, Ill.
Anderson, E. G., Sargent & Lundy, Chicago, Ill.
Edgar, R. B., U. S. Navy, Chicago, Ill.
Hupp, R. L. (Re-election), Gen. Elec. Co., Fort Wayne, Ind.
Jochums, W. V., Caterpillar Tractor Co., East Peoria, Ill.
Johnson, W. J., Ill. Bell Tel. Co., Peoria, Ill.
Johntz, T. E., Gen. Elec. Co., Chicago, Ill.
Lindahl, E. H., Gen. Elec. Co., Chicago, Ill.
Morris, C. H., Klaus Radio & Elec. Co., Peoria, Ill.
Parkes, J. S., Fisher Body Corp., Detroit, Mich.
Poticny, J. V., Leece-Neville Co., Cleveland, Ohio
Setzer, M. W. (Re-election), Mason & Hanger Co., Baraboo, Wis.

6. North Central

Baer, O. W., U. S. Bur. of Reclamation, Denver, Colo.

7. South West

Beard, O. K., Gulf States Util. Co., Beaumont, Texas
Jones, T. A., Lower Colo. River Auth., Buchanan Dam, Texas
Richards, D. C., Magnolia Pet. Co., Dallas, Texas
Turley, L. R., Pittsburgh Plate Glass Co., Crystal City, Mo.

8. Pacific

Brant, R. A., Sacramento Air Tech. Serv. Com., Sacramento, Calif.
Carey, J. C., Bendix Avia., Inc., Los Angeles, Calif.
Clardy, C. C. (Re-election), Rohr Aircraft Corp., Chula Vista, Calif.
Govan, E. L., Guy F. Atkinson Co., Boulder City, Nev.
Maves, W. W., A. O. Smith Corp., Los Angeles, Calif.
McCosh, R. E., Ensign, U.S.N.R., San Francisco, Calif.
Palmer, E. W., U. S. Naval Dry Docks, San Pedro, Calif.
Weisinger, R. E., Consolidated Vultee, San Diego, Calif.

9. North West

Gerhardstein, C. V., C. M. St. P. & P. R. H., Butte, Mont.
Heuser, E. R., I. B. E. W., Spokane, Wash.
Kish, S. A., Northwestern Agencies, Seattle, Wash.

10. Canada

Guess, A. L., Can. Gen. Elec. Co., Ltd., Toronto, Ont., Can.
Osberg, G., Royal Can. Navy, Ottawa, Ont., Can.
Wardale, C. W., Northern B. C. Pr. Co., Ltd., Prince Rupert, B. C., Can.
Wilson, H. O., Lieut. Comdr., R.C.N.V.R., Ottawa, Ont., Can.

Elsewhere

Agarwal, S. N., Phoenix Mills, Ltd., Bombay, India
Carfrae, W. J., British Thomson-Houston Co., Ltd., Rugby, England
Chaudhri, D. P., Delhi Polytechnica, War Tech. Training Centre, Delhi, India
Jarvis, W. M., F./O, Royal Aircraft Establishment, Farnborough, England
McDonald, N. E., Parkes Mun. Council, Parkes, N.S.W., Aust.
Morris, W. A., East Anglian Elec. Sup. Co., Ltd., Britland, England
Perez Canto, F., Int'l. Gen. Elec. S. A., Inc., Caracas, Venez., S. A.
Sahgal, S. S., Lahore Elec. Sup. Co., Ltd., Lahore, India
Shukla, S. G., Ahmednagar Elec. Sup. Co., Ltd., Ahmednagar, India
Soriano R., A., C. A. la Electricidad de Caracas, Caracas, Venez., S. A.
Stinglhamber, R., Ministry of Economics, Brussels, Belgium

Total to grade of Associate
United States and Canada, 80
Elsewhere, 11

OF CURRENT INTEREST

Pursuit of Science—An Urgent Need

Among the many appeals being made these days for draft deferments of technical students and personnel in an effort to conserve potential scientific workers for the postwar world, is the special bulletin issued jointly by the Higher Education and National Defense and the National Research Council under date of May 28, 1945. This 32-page pamphlet entitled "The National Stake in the Imperative Resumption of Training for the Scientific Professions" has been prepared to assist those in and out of the government who are seeking a solution of this vital issue.

The war has not stopped or reversed the technological trend of the past few decades, namely, the expanding use of technically trained personnel in industry, and the job of reconversion as well as the job of exploiting scientific and engineering advances for the purposes of new production will fall on research and development facilities. To maintain its way of life the United States must have an expanding economy which means increased numbers of high-grade scientists and engineers with adequate facilities at their disposal. Besides, other countries are going to depend upon the leadership of the professionally trained men and women of the United States for help in becoming going concerns. Yet training in all the fields upon which the technological civilization most directly depends has practically ceased. The virtual abolition of deferment, the sharp curtailment of college military programs, and the refusal of the military authorities to assign men for scientific training have almost completely stopped the flow of men into the technological fields.

Such conclusions in this report were supported with evidence on the supply and demand for highly trained personnel in the immediate postwar years. The National Roster of Scientific and Specialized Personnel published in May 1944 a report based on a survey made through the facilities of the United States Employment Service which showed a vast unsatisfied demand for technically trained personnel ranging from 20 to 40 per cent of numbers then employed in several categories of science and engineering. The roster estimated at that time that the accumulated total need on the part of American industry was likely to be 40,000 scientists and engineers by June 1944.

Mention is also made in the report of the Purdue University's poll of more than 100 companies to determine the present situation with regard to the need of highly trained personnel (*EE*, June '45, p. 234). This showed a shortage of nearly 5,000 engineers for a small cross section of American industry alone.

Nor is industry the only user of technically trained personnel. Federal activities in control, in counsel, in standardization, and in research have greatly stepped up the number of scientists and engineers needed in government. Stimulation of government activities in this direction after the war will be necessary to maintain research for military purposes and to revive the developments set aside by the war. Then, too, the foreign demand for equipment for laboratories, shops, power plants, and communications as a basis for reconstruction, will be urgent.

This demand will lead to a vast expansion of activities in the training of foreign students. In the large technological colleges foreign students will become a large part of the whole enrollment. Data from the Massachusetts Institute of Technology indicate that present enrollment of foreign students is twice that in prewar years and the number of applications four times as large. In the same institution the ratio of United States students to foreign students on the undergraduate level was 13 to 1 in 1939 but in 1945 the ratio is reversed and is now three foreign students to one United States student. As a further evidence of what may be expected the Indian government is sending 250 holders of national fellowships to the United States for advanced work in the sciences. These will be distributed among the universities since only a small fraction of them can be accommodated in any one institution.

Specifically in the case of engineering, the Society for the Promotion of Engineering Education reports enrollments in engineering in American colleges of something more than 110,000 in 1940–41, the last "normal" year, about 50,000 in 1943–44 and about 38,000 in 1944–45, of whom however, 17,000 were freshmen, most of whom were awaiting induction.

Contrasting practices in the United States with other countries, the report specifically refers to Russia where training in engineering and the sciences has been vastly stimulated during the war. In England, too, students in the technological branches in good standing and who are deemed by the faculties as likely to finish the training in the required time are held at the university to finish the courses. Joint Recruiting Boards with the assistance of the faculties defer students, a practice which has resulted in a steady flow of students in the critical categories at least equal to the prewar norm. In Canada approximately the same method of control has been adopted and stimulation of training in the technological branches has resulted. In the case of Australia, figures are not specifically available. However, data show that at the University of Sydney in 1930 the sciences of engineering, medicine, and dentistry accounted for 38 per cent of enrollments, and arts courses accounted for 62 per cent. In 1944, however, the arts courses accounted for only 9 per cent and the technical courses accounted for 91 per cent.

This Stands for Honorable Service to Our Country

Insigne Issued to Veterans of World War II

Referring to the efforts that have been made to impress Selective Service and War Manpower Commission with the seriousness of the situation, the report urges action in advance of the opening of another school year in September to provide time for institutions to set up administrative procedures for the necessary selection of students on a quota basis. The report suggests modification of existing administrative policies or legislation, and claims that a reversal of policy can be accomplished only by an aroused public opinion acting through such established government agencies as National Headquarters Selective Service System, War Manpower Commission, and the Office of War Mobilization and Reconversion.

New Allocation for Frequency Modulation

A recent decision of the Federal Communications Commission shifts the frequency-modulation radiobroadcasting band for the United States to 88–106 megacycles. Formerly it was between 42 and 50 megacycles. Six channels are assigned to television, one between 44–50 megacycles, three between 54 and 72, and two between 76 and 88 megacycles. Facsimile is assigned the 106–108 megacycle band. The band between who are 50 and 54 megacycles is allocated for amateur use, and the space between 42 and 44, and 72 and 76 megacycles to nongovernment fixed and mobile services.

Conceding that new equipment for use in the vicinity of 100 megacycles would cost more than equipment for use in the vicinity of 50 megacycles "at least temporarily," the commission argued that the benefit to the public resulting from an interference-free service would more than outweigh the slight increase in initial cost.

The testimony of the engineers of the Federal Communications Commission and especially of K. A. Norton (A '41) formerly of the Federal Communications Commission and now a civilian employee of the War Department, was challenged by many objectors at the hearings prior to the rendering of the decision. Among the latter were H. H. Beverage (M '34) associate director of the laboratories of the Radio Corporation of America, New York, N. Y.; C. R. Burrows (M '33) radio research engineering department of the Bell Telephone Laboratories, Inc., New York, N. Y., and G. W. Pickard (F '12) director of research, American Jewels Corporation, Attleboro, Mass.

Stresses Responsibilities of Engineers

The part played by American colleges in training more than 50,000 men to serve as naval officers was called an important factor in winning the war, by Captain Arthur S. Adams, United States Navy (retired) in an address at the commencement exercises of Stevens Institute of Technology, Hoboken, N. J., on June 27. Captain Adams has been in charge of the V-12 training program and is provost-elect of Cornell University, Ithaca, N. Y.

Captain Adams said that the integrity of the individual, and his assumption of personal responsibility for being a human being, were the most important assets that a democracy could have. In addition to their professional proficiency, engineers, Captain Adams emphasized "must constantly be vigilant to recognize their personal responsibilities as citizens, if we are to keep this country great." He said that many engineering students are prone to dismiss all nonengineering matters as uninteresting and unimportant. Pointing out that in order to succeed in engineering, the student must have a capable intelligence, a balanced judgment, and a capacity for hard work, he said that with these qualities he is certain to be able to make a significant contribution to public thinking.

He further explained that a truly educated man, and especially a technically educated man, should concern himself with, and feel responsible for, his development along social, political, and economic lines, just as he does along professional lines, and must make it his business to be informed of all matters affecting the public interest.

Past President Powel in European Assignment

Charles A. Powel, junior past president, AIEE, and manager headquarters engineering departments, Westinghouse Electric Corporation, East Pittsburgh, Pa., was selected by the War Department to be chief of the electrical and radio branch in the United States Group Control Council for Germany. According to the Army his immediate task will be the surveying of the facilities in the American zone of occupation, the establishing of controls under which German industries will be permitted to revive, and the seeing to it that these industries are so organized that they cannot become potential producers of war material.

Advances Made in Synthetic Rubber

Production of synthetic rubber has reached a grand total of 1,400,000 long tons since the start of the Government's program. This fact is contained in a study entitled "Report on the Rubber Program, 1940–45," by S. T. Crossland, executive vice-president of the Rubber Reserve Company, a subsidiary of the Reconstruction Finance Corporation. Production of 737,000 tons for the year 1944 was greatly in excess of the largest amount of natural rubber consumed in the United States in any prewar year. On quality the report states that tires of passenger-car size are being built out of substantially 100 per cent synthetic rubber. The use of butyl rubber in the manufacture of inner tubes and of other products where pneumatic (air retention) properties are important, has been successful and is expanding.

OTHER SOCIETIES •

Engineer Describes Development of Electric Tank Turret

Development of a new electric drive for the turret of the General Sherman tank, with acceptance tests completed on the eve of Pearl Harbor, was described by Stanley J. Mikina (M '41) electromechanical research engineer of the Westinghouse Electric Coporation, East Pittsburgh, Pa., before a recent section meeting of the American Society of Mechanical Engineers in Chicago.

The project of developing an electric turret-traversing mechanism for tanks was undertaken by Westinghouse at the request of the Army Ordnance department in February 1941, Mr. Mikina said. Its object was to supply the Army with another source of supply of turret drives for the new M4 tank, in addition to the hydraulic drives then employed.

In his illustrated paper, Mr. Mikina described in detail the methods of developing the new mechanism. It was felt at the Westinghouse laboratories that by applying principles of electric control learned in peacetime applications to steel-mill tension regulators and positioning systems, it would be possible to develop an electric drive for tank turrets that would in some respects be superior to the established hydraulic drives.

By utilizing the previously developed Silverstat control, together with gyroscopic means for elimination of unstable oscillations, a positionally regulated drive was created which enabled the tank gunner to point the turret gun over the full circle of travel with the same facility as if he were aiming a light rifle. A force of two pounds on the handle of the control handwheel was sufficient to move a heavily armored turret weighing 12,000 pounds.

Synthetic Fuels Made by Bureau of Mines

To a special Senate committee investigating petroleum reserves, M. V. Straus, Assistant Secretary of the Interior, recently said that the Bureau of Mines was making synthetic fuels and "good" gasoline, that was driving internal-combustion engines. He declared that the completion of the $30,000,000 synthetic fuels demonstration program authorized by Congress would go a long way toward the establishment of a synthetic fuels industry and independence for the United States in natural resources.

New Officers of Illuminating Engineering Society

Albert F. Wakefield, president of the F. W. Wakefield Brass Company, Vermilion, Ohio, has been elected president of the Illuminating Engineering Society.

Mr. Wakefield has been active in the society for more than 25 years, serving on numerous nontechnical committees before his election as vice-president in 1943. He is a former chairman of the commercial lighting equipment section of the National Electrical Manufacturers Association, and has served on both the incandescent and fluorescent lighting equipment advisory committees of the War Production Board, Washington, D. C.

Mr. Wakefield is as well known in marine circles as he is to the lighting industry. He has been active in the development of harbors and refuge for small craft on the Great Lakes and has been an influence in the development of water areas for recreational purposes.

The Illuminating Engineering Society was established in 1906 to encourage the broadening of scientific study as a basis for better illumination.

Other national officers elected by the Illuminating Engineering Society include L. E. Tayler of the Detroit (Mich.) Edison Company as general secretary; Bruce J. Jensen, Public Service Electric and Gas Company, Newark, N. J., as treasurer; and R. W. Staud, Benjamin Electric Manufacturing Company, Des Plaines, Ill., as vice-president.

Members Active in Electronics Club, Fort Worth Electronics Club concluded its activities for the year with the June meeting at which J. L. Caudry (A '45), Texas Electric Service Company, Fort Worth, Tex., gave a talk on high-frequency heating. Another feature of the meeting was a reel of sound film which was shown to members and their guests through the courtesy of the General Electric Company, Schenectady, N. Y., on "Sight-seeing at Home." Among officers elected were: P. G. See (A '44) Consolidated Vultee Aircraft Corporation, vice-president, and W. H. Farrington (A '41) Texas Electric Service Company, secretary-treasurer. Directors included: W. C. Fowler (M '36) Sangamo Electric Company, Springfield, Ill.; H. F. Spreen (A '40) Texas Electric Service Company; and J. L. Caudry.

ASTM Approves Materials. At a one-session business meeting held in New York, N. Y., on June 27, the American Society for Testing Materials, Philadelphia, Pa., authorized the adoption as formal standard of some 35 tentatives previously published and the adoption of some 40 revisions in existing standards. The approval of new tentative specifications and tests is an indication of new work resulting from the technical committees' deliberations. These cover tests for resistance of traffic paints to abrasion; for producing films of uniform thickness on panels; analyzing petroleum sulfonates, and several new tests covering paper and paper products. The new officers of the society include J. R. Townsend, materials engineer, Bell Telephone Laboratories, Inc., New York, N. Y., as president; and T. A. Boyd, head, fuel department, research laboratories division, General Motors Corporation, Detroit, Mich., as vice-president.

Physical Society Meets. The 267th meeting of the American Physical Society was held in the physics department of Stanford University, Stanford University, Calif., on July 14, 1945. Nineteen contributed papers and two invited papers were given.

HONORS • • • • • •

Paul Clapp Receives Marston Award

Paul S. Clapp (A '18) vice-president of the Columbia Gas and Electric Corporation, Columbus, Ohio, was presented the Marston Medal by the Iowa State College, Ames, at its graduation exercises on June 16.

The Anson Marston Award, consisting of a suitable gold medal, was established in 1938 by Iowa State College through the inspiration and generosity of Anson Marston, dean emeritus of engineering. It is awarded, not oftener than once each year, to an engineering alumnus of at least 30 years' standing for achievement in engineering in a broad field. The award is made by a board consisting of four alumni, a representative each of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Chemical Engineers, and the dean of engineering who will serve as ex-officio chairman of the board.

An account of Mr. Clapp's professional career is given in the "Personal" section of this issue.

Honored for Advancing Industrial Science. In tribute to his leadership in advancing industrial science, Clyde Williams, director of Battelle Memorial Institute, Columbus, Ohio, was presented the degree of doctor of science at recent convocation ceremonies of the Case School of Applied Science, Cleveland, Ohio. The degree was presented by Doctor William E. Wickenden (F '39) president of the school who cited Mr. Williams' accomplishments in research administration and in directing the activities of the war metallurgy committee of the National Academy of Sciences and the National Research Council.

Yank Soldier Wins Suggestion Award. Melvin Jacobson, a private in the United States Army, who is on military leave from the Westinghouse Electric Corporation, East Pittsburgh, Pa., sent a report to the plant suggestion committee about an unusual lamp socket he had found in Germany. The description was turned over to engineers of the company who found it impractical for American use. However, the committee awarded Private Jacobson $15 for his thoughtfulness and his desire to assist in the productive effort at home. The socket is made of plastic and has a small alloy current contact.

War Worker Earns Top Westinghouse Award. The highest award for suggestions ever made in the 35-year history of the suggestion system of the Westinghouse Electric Corporation, East Pittsburgh, Pa., was presented recently to a retired real estate operator who entered war work after Pearl Harbor and was engaged at the lamp division's electronic tube plant at Bloomfield, N. J. The suggestion resulted in an estimated annual saving of $30,630 to the nation's war effort.

RESEARCH • • • • •

Scholarship Fund Honors Ex-President Swope

To assist in higher education and fundamental research work in scientific and industrial fields, a fund of $400,000 has been set aside by the directors of the General Electric Company, Schenectady, N. Y., to be known as the Gerard Swope Foundation. Mr. Swope (F '22) served as president of the company from May 1922 until the end of 1939, and for an additional two years in 1942–44 he returned to head the company when C. E. Wilson (A '16) now president, was acting as executive vice-chairman of the War Production Board. The directors announced that the new foundation was created as an expression of appreciation and as a means of making this appreciation of enduring and constructive benefit to the company and to the electrical industry.

DISPOSITION OF FUND EXPLAINED

The income of the foundation will be utilized in the following ways:

1. In granting loans or scholarships to employees and to the children of present or former employees of the company and its affiliated companies, to help them pursue their work in any field of study and in any approved university, college, or technical school in the United States.

2. In granting graduate fellowships to the same classifications of individuals to be used by the recipient for graduate work in industrial management, engineering, the physical sciences, and in any other scientific or industrial field.

3. In granting loans, scholarships, or fellowships in any of the above fields to any other person that may be deemed worthy of assistance.

4. In granting graduate fellowships, to make contributions to the university, college, or technical school to help in defraying the cost of equipment and material, especially needed in connection with a research project.

Applicants for loans, scholarships, and fellowships will be considered not only from rhe standpoint of academic attainment and financial needs, but also as to character and personal qualifications.

It is planned to make a statement of awards under the foundation in each of the company's annual reports. Details of administration are to be announced later.

Research Laboratories at Pennsylvania State College

The United States Navy has completed arrangements for the establishment of two permanent ordnance research laboratories which will be in operation by fall at the Pennsylvania State College, State College, Pa., under a Bureau of Ordnance contract. The establishment of these laboratories is in keeping with the bureau's broad policy of forming research affiliations with educational institutions to further development of naval weapons and for educational purposes in the postwar period.

The Ordnance Research Laboratory, dealing with underwater ordnance, will be housed in a new building now under construction on the campus. The work will be a continuation of the research formerly carried on by the Underwater Sound Laboratory at Harvard University which has been sponsored by the Office of Scientific Research and Development, with technical direction from the Bureau of Ordnance.

Eric A. Walker (M '41), who was in charge of the Ordnance Research Division at Harvard, will direct the new laboratory. A brief account of Doctor Walker's career is given in the "Personal" section of this issue.

Assistant directors of the Ordnance Research Laboratory will be A. N. Butz, Jr. (A '45), who formerly operated a private electronics research laboratory, R. R. Thompson, formerly associated with Bell Telephone Laboratories and the Humble Oil and Refining Company, and Doctor Harvey Brooks. All of these men are now affiliated with the Harvard University Laboratory. A staff of approximately 125 scientists, technicians, and clerks will be transferred from the Harvard Laboratory to the new unit. In addition to the work that will be undertaken on the campus, this laboratory will also operate a calibration station at the Black Moshannon Lake, approximately 20 miles from State College, and a test station at Fort Lauderdale, Fla.

The Petroleum Refining Laboratory has been in operation for approximately 16 years at The Pennsylvania State College. During the present war emergency, it has also been under the sponsorship of the Office of Scientific Research and Development. The plan is for this laboratory to continue with the petroleum research under a direct contract with the Bureau of Ordnance, including special work for and technical reports to the other services. Doctor M. R. Fenske will continue as director of the Petroleum Refining Laboratory, a position which he has held since it was established. The staff of this laboratory includes more than 50 chemists, chemical engineers, and technicians.

The Ordnance Research Laboratory has been placed under the School of Engineering by The Pennsylvania State College, and the Petroleum Refining Laboratory is under the School of Chemistry and Physics.

New Research Directory in Prospect

The eighth edition of "Industrial Research Laboratories in the United States," the directory of the National Research Council, Washington, D. C., is being compiled.

Laboratories in the field of electrical engineering are invited to send for questionnaires. Laboratories which reported in 1940 have had their printed statements sent for revision. There is no charge for the inclusion of a statement regarding a laboratory, and no obligation is incurred in furnishing data.

The seventh edition appeared in 1940, and contained information on industrial research laboratories of 2,264 companies and their subsidiaries. The term "research" for the purpose of the directory is construed as including investigations looking toward the improvement of products, or the reduction of cost of manufacture as well as fundamental research and applied research. It does not apply to laboratories concerned only with commercial testing.

Science Points the Way to a Better Life

"Men now living may well see the day when a nation's true hidden wealth will not consist of her natural raw materials, but rather consist of her men of science and their laboratories." With this conviction John W. Thomas, chairman of the Firestone Tire and Rubber Company, New York, N. Y., addressed the American Institute of Chemists meeting in Columbus, Ohio, on May 11, 1945. Doctor Thomas expressed the opinion that the next 50 years would bring changes and improvements in the way of life that will overshadow the accomplishments of the past 50 years. But, he claimed that permanent peace is the requisite for a full life and that science may be the chosen arbiter to bring this condition about. The approaching evolution in present-day living will depend on the intensity and earnest application with which untrammeled scientists pursue their work. Doctor Thomas argued that if every nation could possess within its boundaries all of the raw materials it needs to live and to prosper there would be little if any cause for wars. Though this may seem like a dream it was, he said, a dream that can be realized at least in part through the medium of scientific research. He claimed that the scientific investigator does not know the meaning of "it can't be done." He only knows that "it never has been done." And just as the same scientific spirit conquered the forces of evil it can also be applied to making life better for all mankind.

Russia Honors Science. The 220th anniversary of the Academy of Sciences founded in 1725 by a decree of Peter I, has been celebrated by the Russian government. Invitations to a festival were sent to a large number of British, American, and other scientists to attend a series of events in Moscow and Leningrad from June 15 to June 28. Among the specialists invited by the Russian government to make the trip in a specially provided Soviet plane were E. U. Condon (M '44) associate director of the research laboratories of the Westinghouse Electric Corporation, East Pittsburgh, Pa., and A. Nadai, consulting mechanical engineer of the corporation. Several papers were presented at meetings and discussions were held.

Scientific Tolerance—Major Duty to Society

A plea for scientific research in the days immediately after the war was vehemently voiced by H. E. Fritz, director of research, B. F. Goodrich Company, Akron, Ohio, speaking before the recent annual conference of the American Welding Society in Cleveland, Ohio, on the subject "Research an Irresistible Force." Claiming that nature's treasure chest was the only safe frontier left for the United States to exploit, he said the process meant "an attempt to know more, about more, so that we can have more, more of the time." This search resulted in an overflowing reservoir of fundamental new knowledge which was the best insurance policy of freedom for any freedom-loving nation.

Scanning the accomplishments of science between the World War I and II he proved conclusively that there is no phase of civilization today that is untouched by science and research. He warned his listeners that research and trial must be continued if the standard of civilization in the United States is to be sustained, and urged encouragement to those people who will be plowing new fields. To promote tolerance and comprehension for those new revelations which the human mind would uncover is a major duty to society.

EDUCATION • • • •

Columbia University Blazes New Trails. Six regional organizations will be initiated at Columbia University, New York, N. Y., for the purpose of studying the life and thought of principal areas of the world and understanding the social, economic, and political problems of peoples who will play an important role in shaping the world of tomorrow. The Russian Institute, established through a grant of $250,000 from the Rockefeller Foundation, will be the first to be opened on July 1, 1946. The British Commonwealth of Nations, East Asia, Latin America, France, and Germany will constitute the other five institutes. These institutes will be staffed by groups of outstanding scholars who have specialized in one of the pure or applied sciences of human conduct with special reference to some specific geographical area. An announcement has also been made of the formation of a School of International Affairs to function in close cooperation with the institutes. The curriculum of this school is designed to train graduate students for service in technical and managerial posts in government agencies maintaining a foreign service.

Wanted—Building for Engineering Students. A $400,000 money-raising campaign to defray the cost of another four-story wing on the Engineering Building at the University of Southern California, Inglewood, is in progress. The present building was built in 1939 to accommodate 350 students, and it now has 750 full-time day students on its rolls and is used by 2,200 evening-school students including those taking war-training courses. Though construction on two small one-story buildings has been started to make room for research laboratories these additions will not relieve the need for the engineering wing.

Refresher Courses at Houghton. The Michigan College of Mining and Technology, Houghton, has established a correspondence-course program intended primarily for former students, especially those in the armed services. It will consist of 60 courses. One fourth are noncredit refresher courses; the rest carry credit. They are being offered by nearly all departments, both service and degree-granting. It is expected that instruction will begin in many of the courses in the early fall. The college has also established a public relations division which became operative on July 1.

Flying Fortress for Nonflight Use. A $330,000 "Flying Fortress" has been sold under the Reconstruction Finance Corporation's educational distribution program to the Williamsport, Pa., Technical School for $350 for use as a ground aeronautical laboratory. The airplane is reputedly a veteran of many bombing missions over Europe.

Liberalizing General Science. A new general science and arts course has been established at the Colorado State College of Agriculture and Mechanical Arts, Fort Collins, Colo., which will permit students to elect 40 per cent of their courses. It is expected that most students will, under faculty guidance, select some specific scientific interest in their senior year. The new program will appeal to pre-medical students or those looking forward to graduate work.

Electron Microscope at McGill University. A Radio Corporation of America electron microscope has been installed at McGill University, Montreal, Quebec, Canada, for extended work in physics, biology, medicine, chemistry, and metallurgy. Scientists are using the instrument for war research, and important peacetime studies are also projected. Using electrons instead of ordinary light the electron microscope has a resolving power so great that a magnification of 100,000 diameters can be realized.

Stevens Institute Camp Reopened. Ralph Bown (F '41) director of radio and television research, Bell Telephone Laboratories, New York, N. Y., was one of the lecturers at the Junior Camp of the Stevens Institute of Technology at Johnsonburg, N. J., at its 13th annual session from July 15 to July 28. The Stevens Junior Camp was reopened for the first time since 1942. The two weeks' session was devoted to helping young men of high-school and preparatory-school age determine the vocation for which they are best fitted. Guest lecturers in the various branches of engineering described the work of their respective fields.

JOINT ACTIVITIES

ASA Broadens Scope for Postwar Work

Changes have been made in the constitution of the American Standards Association that will enable it to meet more fully the needs of government and industry in the postwar period. The national trade, technical, and governmental groups that make up the association have ratified the changes, the principal one of which will remove present restrictions limiting the work of the association "to those fields in which engineering methods apply" so that the organization can in future handle any standard or standardization project which is in the field of engineering or consumer goods or in any other field which deserves national recognition.

Discuss Screw Thread Standards. Technical men from the Army and Navy, as well as from the automobile, aircraft, machine tool, electrical, and other industries met in New York, N. Y., recently under the auspices of the American Standards Association to work on a series of standards for the threaded parts that go into aircraft engines, pipes for aircraft fuel lines, aircraft control mechanisms, instruments, and miscellaneous industrial applications. The purpose of these meetings was primarily to consolidate the American point of view before the expected gathering of British, American, and Canadian technical experts at Ottawa, Ontario, Canada, in the fall under the auspices of the Combined Production and Resources Boards of which all three countries are members. The American Society of Mechanical Engineers and the Society of Automotive Engineers are joint sponsors of the ASA peacetime project on screw threads and are co-operating closely in the war work.

WAR PROGRAM

Invisible Dye Aids Tropicalization

The United States Army Signal Corps Laboratories have recently developed an invisible dye to facilitate inspection of treated equipment. This invisible or fluorescent dye is mixed with the lacquer which is sprayed over radios, field telephones, and other communication equipment to prevent inroads of fungus and moisture.

All the lacquers, whatever their content, are colorless, or nearly so, in order that the numbers and the identification marks on the various instruments may be plainly read through them. The result is that it is not easy, by ordinary vision, to check on the thoroughness and evenness of the spraying. To aid in this, a special lamp, strong in its emission of ultraviolet rays and equipped also with a deep purple filter, comes to the aid of those responsible for inspection. This lamp, directed upon the equipment, picks up the ultraviolet dye in the lacquer (though it is quite invisible to the eye) and shows with any imperfections in the spraying.

A simple field expedient which can be used in war theaters to discover weak spots in the spraying is to try writing upon lacquered equipment with an ordinary pencil. Wherever the pencil glides as if on glass the spraying has been adequately done. If it "starts to write" it has found a weak spot. Often the tropicalization of communication equipment can then be completed in the field.

American Contributes to Pipeline Feat. Manufacture of materials in the United States substantially aided in the construction of 20 emergency oil pipelines across the English Channel by British engineers according to Colonel H. R. Lynn, technical and military adviser to the British Petroleum Warfare Department. Colonel Lynn said that much credit for the project should also be given to Doctor L. M. Goldsmith (M '26) chief engineer of the Atlantic Refining Company, Philadelphia, Pa., for his advice during preliminary work on laying the pipelines. The Channel operation was called "Pluto" by the British, meaning pipelines under the ocean. Doctor Goldsmith is also consultant to the United States War Department. His services were loaned to the British at the request of Major General Sir Donald Banks of the British Petroleum Warfare Department.

Engineers in Training for Pacific War

In rehearsal for the roles they will play in building bases for carrying the war to Japan, members of the Army Engineers Corps are undergoing a course of intensive study and training at the East Pittsburgh, Pa., plant of the Westinghouse Electric Corporation. Under the supervision of Lieutenant John A. Schaefer, of Fort Belvoir, Va., the service engineers are acquiring information on installing, operating, and maintaining electric generators, transformers and switchgear destined to bring light and power to military installations where no previous power existed in the Philippines, Iwo Jima, and other far-off Pacific battlegrounds. The 53 military students, constituting the first group, possess some engineering background and all have been chosen because of particular aptitude in that field. The course includes classroom lectures and discussions, demonstrations in shop and laboratory, a visit to the Westinghouse plant at Sharon, Pa., to study transformers, and the actual handling of power equipment.

The course of instruction at the East Pittsburgh plant is being co-ordinated by the Westinghouse student training department.

Radio Receivers For Enlisted Men Overseas

To provide entertainment and to aid morale of enlisted men overseas, more than 50,000 sets of a new radio receiver, *R*-100/URR, are being distributed to troops at overseas installations. Procurement orders call for manufacture of over 100,000 sets which will be issued on the basis of one set to every 50 enlisted men except where isolated units number less than 50. The sets are not for use in the United States nor will they be available to officers' clubs nor groups of officers overseas until recreational needs of enlisted men are fully met.

Controls are much simpler than those in other Army radios. The antenna is reeled into the back of the cabinet in such a way that it can be quickly unwound and slung over the nearest tree branch. The control panel is recessed far enough so that nothing protrudes, and the sets can be stacked and shipped without danger of damage. A built-in loudspeaker and headset jacks accompany the receiver, and flexible antenna wire is provided as a part of the set. The entire receiver is fungus and corrosion resistant. Transformers and chokes are potted for protection against the humidity of the tropics. The steel cabinet is light in weight but will withstand heavy shocks. The receiver provides reception of medium and short-wave broadcasts. It operates from self-contained batteries or on direct or alternating current. It is adaptable for use with several different types of standard Signal Corps batteries. This new radio receiver was developed and standardized by the Signal Corps.

Enemy Patents Licensed to Americans. Of the 45,000 patents and patent applications seized by our government from enemy aliens and nationals of occupied countries, 9,366 of the inventions have been licensed to 760 American firms and individuals. Included in the block are about 29,000 of German origin, 7,800 French, 1,800 Italian, 1,300 Dutch, 1,200 Japanese, and the remainder miscellaneous enemy and enemy-occupied origin. This statement was made by Dexter North, chief of patent administration of the Alien Property Custodian's office, Washington, D. C., who turned over the working drawings on this collection to the Midwest Research Institute, Kansas City, Mo., as a repository for the seized patents. The Kansas City institute, a nonprofit scientific research organization was established and is controlled by leaders of the Middle West to industrialize the mineral and agricultural resources of the region. Many of the inventions represent some of the finest achievements of research talent in Europe. Rights for lifetime use of patents of enemy countries may be secured for a fee of $15. A similar fee is charged by the Alien Property Custodian for use of patents originating in nonenemy and occupied countries, plus a small royalty. The file is accessible at all times to manufacturers, agriculturists, educational institutions, and others.

POSTWAR

War Memorial for Cleveland. A War Memorial for the heroes who sacrificed their lives in World War II will be built on the Mall in downtown Cleveland, Ohio, as soon as materials become available. This project is being sponsored by the *Cleveland Press*, which is currently backing a drive to raise $100,000 for a fountain, for which preliminary designs have been made by the lighting division, of the Westinghouse Electric Corporation, East Pittsburgh, Pa. Plans call for a pool approximately 130 feet in length by 110 feet in width with cascading water displays grouped in an elevated basin and centering around a single solid jet rising to a height of 70 feet. Lighting effects will vary, as will combinations of water displays through a cycle lasting 30 minutes. Names of the more than 3,000 servicemen from the greater Cleveland area who died in service will be perpetuated on bronze plates around the top of the main pool wall. All water displays will be illuminated at night by means of specially designed floodlights submerged in the water of the basin and the pool. Lamps as large as 1,500 watts would be used to obtain the required intensities. The floodlights equipped with color lenses producing red, amber, green, blue, or white light will be separately controlled by means of electrically operated dimming equipment, whereby one color is gradually blended into the next throughout the cycle.

Advice for the Veterans. A Veterans' Advisement Center is to be established at the Rochester, N. Y., Institute of Technology. This center, one of four in western New York, will work in conjunction with the Rochester Institute's counseling center which has operated as a clinical counseling and testing service for more than four years.

INDUSTRY • • • • •

Boom in Television Predicted. Analyzing the immediate and long-range prospects of the radio industry in the United States, Brigadier General David Sarnoff (M '23) president of the Radio Corporation of America, New York, N. Y., predicted recently that television will equal the expansion of sound broadcasting after World War I. He said that some 200 new types of electron tubes had been developed by the corporation in the war years, and that when civilian production gets the go-ahead signal the making of home radio and phonograph sets will get under way in 60 to 90 days and television in nine months to a year. He further stated that substantial reduction in the size of many models, including the "personal" type, will be possible through use of miniature electron tubes. It is his opinion that the opening of the microwave region of the radio-frequency spectrum points to many new services in the "citizens radio" field, such as personal radiotelephone equipment resembling the war aid, the "handie-talkie."

Newsletter on Electronics Announced. *Electron*, a newsletter of electronics and television, is a new weekly periodical published by Legend House, Inc., New York, N. Y., and designed to keep executives and engineers informed of the latest developments in electronics and television. This publication is under the editorial supervision of Harold Prince, former editor of *Bakelite Review*.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Depletion of Ranks of Scientific Students

To the Editor:

During recent years the number of students in electrical engineering has dropped precipitously in spite of the accelerated programs and will drop still further when the full impact of all factors is realized. Figure 1, compiled from tables given at various times in the *Journal of Engineering Education*, illustrates this point.

The fact that the number of doctoral candidates and doctoral degrees granted has dropped to practically zero has been well emphasized in other publications,[1,2] but for further emphasis the figures are present again in Figure 2.

Both of these facts show the influx of new engineering man power has been depleted seriously during the national emergency.

To these two other factors must be added. First, a great many of the young men graduating in electrical engineering or allied sciences have been inducted into the Armed Forces where, although some have been given additional scientific training, it is hardly to be expected that this has been of great use in furthering their professional growth. Moreover, many will have been introduced to nonscientific pursuits in which they will remain after the emergency, because they will wish to make use of any special training, or are unwilling to undertake the training necessary to claim their expected place in the profession.

A somewhat more specialized depletion has taken place in the ranks of engineering teachers, since many of them have been drafted from their normal teaching pursuits to work in scientific laboratories sponsored both by industry and government agencies and now, as the emergency ends, do not intend to return. This is not an unqualified loss to the profession as a whole, but it will deplete the number of competent engineering teachers and reduce the quality of the neophyte engineers, since many of the best teachers have been so diverted.

There is no question concerning the value of the scientists' contributions to the war effort. No one will question that engineers, working at their own profession as civilians and in many cases in their permanent jobs, have contributed more to the successful prosecution of the war than they might have done if drafted indiscriminately into the Armed Forces. Engineers have contributed many new ideas for new weapons, assisted in their development and test, and checked their use by the Armed Forces. Their tremendous contribution has been evident in the production records established by this country. Indeed, in an address before the AIEE in May 1941, a representative of one large manufacturing company predicted that it would take 14 workers on the home front to support one soldier in the field. This has been disproved, since this country with about 60,000,000 workers has supported an Armed Force of approximately 11,000,000 men and has supplied tremendous amounts of equipment to the Allies. Such figures only reinforce one's opinion of the effectiveness of a few hundred thousand engineers and production specialists working at their own profession.

Now half of the war is ended, and we can look forward with considerable certainty to a successful finish within the next year or so. Then will begin a period of growth and reconstruction which will tax our technical man power to the utmost. Our allies, Russia and Great Britain, long have recognized this situation and, although much harder pressed than we ever have been, they have made a

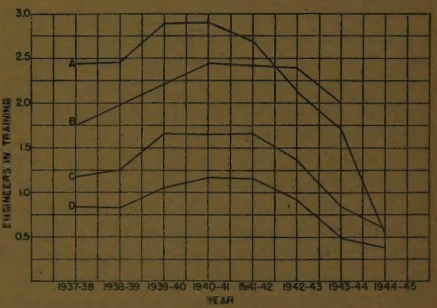


Figure 1. Engineers in training

A—Number of electrical engineering seniors (× *1,000*)

B—Number of electrical engineering degrees (× *1,000*)

C—Number of electrical engineering students (×*10,000*)

D—Number of engineering students (×*100,000*)

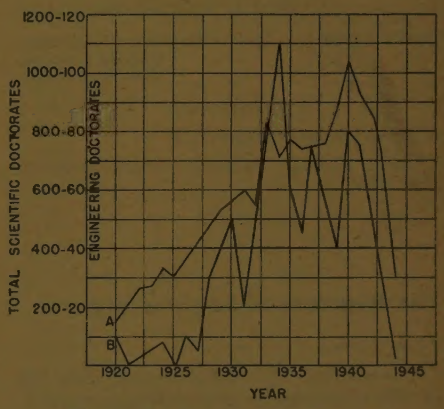


Figure 2. Doctorates per year

A—Doctorates in science (chemistry, mathematics, physics, and engineering)

B—Engineering doctorates

determined effort to preserve the continuity and strength of their technical resources An effort has been made to keep a continual flow of technical students through the colleges and technical institutes. Their scientists and engineers have been encouraged to continue their research throughout the war and have not been drafted to bear arms.

In this country we have approximately 100,000 scientists, engineers, and technicians. If all were drafted, the addition to the Armed Forces would not be great. Yet at this late date there is a very serious threat to the further curtailment of all scientific personnel.

The National Roster of Scientific Personnel and the Office of Scientific Research and Development are authorized to certify research workers for deferment by the local boards. However, these agencies must agree to specific limitations upon the total number of certifications that will be made and that there will be definite limitations on the type of persons to be certified. Under these regulations the research laboratories and colleges are asked to list their personnel in order of decreasing importance and then are asked to state why each person is essential. Obviously it is difficult to explain why a young man but a few years out of college and with no formal training period after a bachelor of science degree is essential. The Selective Service officials fail to realize that reseach work no longer is carried on by a long bearded individual working alone but is done by groups of scientists working as a team. As with a team, the loss of any one member cripples the efforts of all. So from a team point of view every individual, if properly used, is indispensable.

In order to preserve our scientific man power it is essential that a determined effort be made to impress on the Selective Service authorities the importance of this point of view. So far it has not been the policy of our government to defer special classes, and recently a bill to defer farmers as a class was defeated. But perhaps the time has arrived to abandon this principle and defer scientists as a class because of the importance of scientific research and engineering, both through the remainder of the war and in the following reconstruction period. Representation has been made to the War Manpower Commission and Selective Service Director by several scientific societies.[3] Is it not time that the AIEE joined this effort?

ERIC A. WALKER (A '34, M '41)

(Associate director, Underwater Sound Laboratory, Harvard University Cambridge, Mass.)

REFERENCES

1. *Science*, volume 101, pages 172–8.

2. M. H. Trytten. *The Scientific Monthly*, volume 60, pages 37–47.

3. *Science*, volume 101, page 486.

The Romance of Engineering

To the Editor:

The address of C. A. Powel (*EE, June '45, pp. 207–10*) arouses in me a lively appreciation. In my more than 50 years of engineering it has been my good fortune never to lose the wonder aspect out of my life. He rightly emphasizes the seemingly permanent continuance of engineering subjects of intense interest. To the extent that young men, as they grow older, have and retain the ability to see into the inside of things, to that extent they will retain the fresh interest of youth even as long as they live. A Stillson wrench is not merely a wrench, the rubber on a wire is not merely an insulation, a storage battery is not merely lead plates in acidulated water. Each has back of it a line of noble development, each has in it a world of natural laws and ingenious combinations of laws.

For the sake of the young men we are glad for that address.

A. B. SMITH (A '04, F '22)

(Chief research engineer, Associated Electric Laboratories, Inc., Chicago, Ill.)

NEW BOOKS ● ● ●

The following new books are among those recently received from the publishers. Books designated ESL are available at the Engineering Societies Library; these and thousands of other technical books may be borrowed from the library by mail by AIEE members. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books. All inquiries relating to the purchase of any book reviewed in these columns should be addressed to the publisher of the book in question.

Conference Leader Training. By Edward S. Maclin and Paul T. McHenry. National Foremen's Institute, Inc., Deep River, Conn., 1945. 80 pages, $5^{1}/_{2}$ by 8 inches, cloth, \$2.50.

A work-book in the conference method, this manual gives a concise listing of the needs for leadership training and presents in practical form the various devices used in dealing with different situations, as well as the techniques involved in planning and leading discussions. Thirty topics are suggested for conference discussion which cover pretty thoroughly the life of the worker in a plant.

How to Handle Labor Grievances. By John A. Lapp. National Foremen's Institute, Inc., Deep River, Conn., 1945. 294 pages, $5^{1}/_{2}$ by 8 inches, buckram, \$4.

The history of the development of grievance plans, the operation of grievance systems, and the problems which have resulted, make up the subject matter of this book. The work is the outcome of the experience of the author in handling arbitrations of labor grievances and in formulating and interpreting collective bargaining contracts.

Paper and Paperboard. Sponsored by ASTM committee D-6 on Paper and Paper Products, American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa., 1944. 108 pages, illustrated, 9 by 6 inches, paper, \$1.50. (ESL.)

The four parts of this report cover respectively: general considerations and the nature of paper properties; the action of water on paper and its significance; definition of terms, nomenclature, and properties of various classes of paper and paperboard; and a discussion of commonly used tests applied to paper and paperboards and their significance. A complete list of ASTM and Technical Association Pulp and Paper Industry test methods is included.

Universe Around Us. By Sir J. Jeans. Fourth edition revised and reset. University Press, Cambridge, England; Macmillan Company, New York, N. Y., 1944. 297 pages, illustrated, $8^{1}/_{2}$ by $5^{1}/_{2}$ inches, cloth, \$3.75.

This book contains a brief account in simple language of the methods and results of modern astronomical research, both observational and theoretical. Special attention has been given to problems of cosmogony and evolution and to the general structure of the universe. This fourth edition has been largely rewritten in the light of recent advances, such as the application of the physics of atomic nuclei to various stellar phenomena.

English-French Comprehensive Technical Dictionary of the Automobile and Allied Industries. Compiled by L. L. Sell. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1932, reprinted. 768 pages, $7^{1}/_{2}$ by $5^{1}/_{2}$ inches, fabrikoid, \$8. (ESL.)

This dictionary contains more than 150,000 English and French technical terms used in the automobile and allied industries. The list is a very detailed one, covering many phrases as well as words, and both English and American usage have been considered. As many of the terms apply equally to all branches of mechanical engineering, the dictionary will be useful to translators in a wider field than the title indicates.

With the Watchmaker at the Bench. By D. de Carle. Fourth edition. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1944. 239 pages, illustrated, 7 by 5 inches, cloth, \$3. (ESL.)

The early chapters describe the watchmaker's equipment and methods for training the beginner in its use. Succeeding chapters deal with the examination of the movement, the manufacture and repair of watch parts, and cleaning methods. The final chapter covers briefly the use of the watchmaker's lathe. The book is intended to be of use in any branch of fine mechanics, such as aircraft instrument making.

PAMPHLETS ● ● ● ●

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

Geiger-Counter Spectrometer for Industrial Research. By H. Friedman. North American Philips Company, Inc., 100 East 42d Street, New York, N. Y., 8 pages.

Vector Chart for Determining Capacitor Kvar. Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

How to Repair Tractor Parts by Arc Welding. General Electric Company, Schenectady, N. Y., 7 pages.

Electro Rust Proofing System of Cathodic Protection. Electro Rust-Proofing Corporation, Dayton 10, Ohio.

Motors and Control for Hazardous Locations. General Electric Company, Schenectady, N. Y., 26 pages.

Putting Electricity to Work on Your Farm. Westinghouse Electric Corporation, East Pittsburgh, Pa , 52 pages. Five cents.